Exploring the Explorers: Studying the Mood, Mental Health, Cognition and the Lived Experience of Extreme Environments in a Small Isolated Team Confined to an Arctic Research Station

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Abstract

Background: The human ability to adapt to extreme environments is fascinating. Research into this adaptation has been lacking in Arctic isolated teams because it has concentrated on Antarctic teams. The hazards of the poles often confine the researchers indoors with their colleagues, reducing their privacy. This deployment also limits their contact with loved ones at home. Subsequently, over the course of polar night, rates of anxiety, depression, irritability and sleep disturbance increase (Suedfeld & Palinkas, 2008). Often, the teams complain of cognitive impairments. The High Arctic's distinctive feature is the polar bear. The presence of bears requires Arctic research station teams to handle fire arms for their personal safety. It also means that fire arms – which are highly restricted in the Antarctic – are ever-present and easily accessible at Arctic stations. This poses a unique psychological challenge for these teams which has not been well-researched.
Methodology: This thesis is an original contribution to science in that it employs a mixed-methods approach combining phenomenological interviews, cognitive testing and mental health assessment via questionnaires with a team spending a year at the Polish Polar Station, Hornsund, Svalbard. The participants were ten of the eleven winter team members who spent the year between July 2015 and June 2016 at Hornsund ("Explorers") and an age-/gender-/education-matched control group ("Controls"). They filled in the Symptom Checklist-90-Revised and the Profile of Mood States-Brief Version in July, September, January, April and June of that year. Cognitive testing was completed in September, January and June; it comprised the Figural Learning and Memory Test, the Sustained Attention to Response Task (SART), the elevator tasks of the Test of Everyday Attention (TEA) and the Raven Standard Progressive Matrices. The interviews took place at the same time as the cognitive testing.
Results: The results showed that the most stressful time reported in the questionnaires was April 2016, just after the winter isolation had ended and the sun had risen again. The Explorers reported little subjective complaints about their cognition but they performed near-ceiling on the TEA while scoring far below their Controls on the SART. This implies a dichotomy between sustained attention and inhibition in the Explorers. Their lived experiences were shaped by a struggle to adapt to the other team members rather than by struggling to adapt to the hazardous environment. The environment was perceived as awe-inspiring. Over time, the Explorers shifted their view of the team from informal colleagues to a family which they did not choose to be a member of and then, to friends. Unanimously, other people were seen as the most difficult aspect of the mission.
Conclusions: This thesis provides unique insight into a non-Anglo-Saxon Arctic wintering team: the conclusions suggest that participants should receive social training to get along better and be emotionally prepared. The findings can be implemented by my research partner, the Institute of Geophysics (Warsaw) to better select and prepare their future expeditions to Hornsund. Some of the insights such as the nature of the interpersonal stressors may be applicable to space missions.

Lay Summary

This thesis showcases the research into an Arctic expedition team: a group of eleven people who spent an entire year at the isolated Arctic research station at the Polish Polar Station, Hornsund, Svalbard. During this year, they were only allowed to leave in case of medical emergencies.

Over the course of their mission, they repeatedly filled in questionnaires about the mental health and mood. They also took part in tests for their attention, memory, reasoning and inhibition skills. Additionally, they were interviewed about their personal experiences at the station. Their questionnaire and test results were compared to that of a control group who had the same age, sex and education as the expedition members.

The results showed that the most difficult period was the spring: the expedition members felt most depressed and hostile towards others. During the winter, they described immense efforts to suppress this hostility. However, at the end of the mission they found that the winter isolation had been the most pleasant phase at the station because it was more quiet with less work to do. Their ability to inhibit responses was not as good as that of the control group, possibly because they were constantly inhibiting their hostility towards other team members.

These observations suggest that in order to go on an Arctic expedition, people should receive social preparation training as well as safety training. Other people were continuously seen as the most dangerous or unpleasant aspect of the mission. Future research could validate these findings with different groups.

Signed Declaration of Independent Work

1. I, Anna Gesine Marie Temp, am aware of and understand the University of Edinburgh's policy on plagiarism; and I declare that this thesis is an original report of my research which has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where it states otherwise by reference or acknowledgement, the work presented is entirely my own. This includes the presented photographs.

   Parts of this work have been published in:

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2. My contributions to (1) and (2) were as follows: I conceived this study with my supervisors who are the co-authors. I selected the questionnaires, the visual memory and logical reasoning tasks for the data collection, Dr Bak selected the attention tasks. Dr Lee audited the qualitative data. I collected the data, analysed the data, approached the publishers and wrote the publications which both co-authors proof-read.

3. For full transparency and easier access, Appendix B-E to this thesis are available on the Open Science Framework (OSF): osf.io/n894w

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List of Abbreviations

Term	Abbreviation
Australasian Antarctic Expedition	AAE
Automated Neuropsychological Assessment Metrics – Isolated & Confined Environments	ANAM-ICE
International Network for Terrestrial Research and Monitoring in the Arctic	INTERACT
Naval Medical Research Institute – Performance Assessment Battery	NMRI-PAB
Polar T3 Syndrome	PT3
Profile of Mood States	POMS
Raven's Standard Progressive Matrices	SPM
Seasonal Affective Disorder	SAD
Seasonal Pattern Assessment Questionnaire	SPAQ
Sustained Attention to Response Task	SART
Symptom Checklist 90 – Revised	SCL-90-R
Test of Everyday Attention	TEA
Third-Quarter Phenomenon	TQP
Winter-Over Syndrome	WOS

1. Extreme Environments

"…this country is a terrible one to spend a year in."

– from the diary of Captain John King Davis,

the 19th of January, 1912, at Cape Denison, Antarctica

(cited in Roberts, 2014, p. 118)

This thesis will first introduce the field of extreme environment psychology and then review the previous literature in the fields of Arctic and Antarctic psychology of isolated and confined crews. The systematic literature review's aim is to show which empirical methods have already been used, and what has been found. The results of both poles will be compared and contrasted in order to discover gaps in the literature which will inform the research questions and methodological choices of this study. The literature review (see Section 1.4) will show you that Arctic teams have been scientifically neglected in the field of isolation and confinement, and that there are very few qualitative studies compared to the number of quantitative studies in this field. Furthermore, all but two studies focused on negative polar experiences. Based on this, my study will explore an Arctic team's winter experience using well-being questionnaires, cognitive tests and phenomenological interviews over the course of the entire one-year expedition. The measure points will be just after their arrival in the summer; just before the winter; during the winter isolation; in spring; and just before their departure home. The Arctic experience of this team will be compared to that of an age-, gender- and education-matched control group who stayed in their home environment in Edinburgh for the duration of the study.

The second chapter will outline the methodology behind this aim: The Polish Polar Station in Hornsund, Svalbard was the chosen location for this study. Details on the quantitative instruments and the qualitative questions will be provided, too. Additionally, the considerations for quantitative analysis with such a small sample will be discussed before moving on towards the analytical chapters.

Chapters 3, 4, 5, and 6 are the analytical chapters. They show the changes in the Arctic team over time as well as compared to a control group (3), the Arctic team's idiographic experiences of their lives at the station (4), the case study of an Arctic participant who had to withdraw based on his psychiatric complications (5), and suggestions on how to improve selection (6). Chapter 7 integrates and discusses all of these findings with one another.

1.1. Extreme Environments Explained

This section's aim is to provide examples of extreme environments, and explain their effects on humans, as well as the relevance of psychological research into their exploration.

What is an extreme environment, and why is it extreme?

Extreme environments can also be called Isolated and Confined Environments (ICE), implying that they are not specific to any continent, or even planet. There are three key stressors here: the type of environment, the mission of the confined people, and outside communications (Blair, 1991, p. 57). In some of these environments things such as windows, privacy; living green things; animals; the sun; thick, moist air to breathe; and freedom to leave a rumour-infested, isolated human outpost do not exist (Cornelius, 1991, p. 10). This can result in unwanted intimacy with people not of one's choosing and unwanted changes in one's personal thoughts, feelings, and behaviours (Blair, 1991, p. 58).

A number of ICE have been suggested and researched over the years, often with the aim to generalise the effects from one ICE to another. An early type of an ICE is sailors on whaling or exploration ships, who would spend months at sea between ports, and years between homecomings, confined to their boat with fellow crew members (Finney, 1991, p. 93). For example, Douglas (1991, p. 81) points out that Captain Cook's third voyage lasted three years, making it much more arduous than today's space missions. The resultant psychological issues must have been similar. These ships posed mobile ICE, opposed to stationary ones; a stationary ICE is experienced by National Park Servicemen in the United States of America (USA), who undergo considerable isolation and remoteness for the duration of their appointment (Valen & Caldwell, 1991, p. 118). This isolation and remoteness makes their experience comparable to that of nuclear submariners (Weybrew, 1991, p. 103ff), who spend prolonged periods underwater, away from daylight or even the possibility to look out of a window regularly, confined with their crew members. Submariners are a modern-day example of a mobile ICE. Both National Park Service and submarine environments are extreme in the sense that there is limited communication with home for those confined within it. Additionally, their residents have not chosen those whom they are confined with unless they are serving entirely alone, which may be the case for National Park Servicemen.

Two further modern ICE are space missions, and Antarctic research stations. Space missions require their crews to stay inside for activities of daily life; a consequence of survival, however, is near-constant isolation from the crew's home and families.

Antarctic weather conditions confine the scientists and maintenance staff indoors for prolonged periods of time, with abnormal photoperiods. All wintering crew members must take on a constant survival mentality and exert great caution because any individual's performance can affect the survival for the entire crew (Blair, 1991, p. 59). Even the smallest mistake could result in a fire, compromising the station's structural integrity and condemning the crew to an unsheltered Antarctic winter (Levesque, 1991, p. 16). More about this physical environment can be found in Sections 1.2 and 1.3 of this chapter, with the consequences on its inhabitants being discussed in Section 1.4. Following these examples, an ICE can be any living situation that confines an individual - or a group of people - to a remote location, with limited communication possibilities with the rest of their home societies and limited possibilities of leaving that location, for prolonged periods of time.

Why study ICE?

As mentioned previously, scientists hope to study one ICE in order to draw conclusions suitable for others; for example, to compare the Antarctic habitats to space and underwater habitats (Carrère, Evans & Stokols, 1991, p. 236) and extrapolate recurring factors. The purpose of such research stations is to offer a platform where data from this specific environment can be collected, analysed and shared (INTERACT, 2014, p. 192). Suedfeld (1991b) points out that across Antarctica and space, the crews are very similar: both feature highly professional people pursuing career goals and facing life-threatening circumstances. As such, Antarctic psychological research can be more readily applied to space ICE habitats than sensory deprivation studies where participants spend time doing nothing in a dark, sound-proof room (Suedfeld, 1991a, pp. 135-136). Pierce's (1991, p. 125) three phases of Antarctic and space missions are also absent in these studies; namely pre-embarkation, mission and re-entry. Suedfeld (1991) nevertheless points out that it is not clear whether Antarctica is a good space analogue due to the different psychological expectations between space and Antarctica. However, useful suggestions for the design of space stations have come from Antarctic research, including the colours and foods that should be present and the distribution of personal space for the station (Suedfeld, 1991a, pp. 136-137).

There are many areas where Antarctic research can inform space mission planning, such as crew selection, training and preparation of the crew for their mission, performance enhancement while on the mission, and minimising any potential for undesirable long-term effects (Palinkas, 1991a, p. 240). One of these can be depression, which in Antarctica manifests social withdrawal, hostility, irritability, and decreased motivation and performance; this can cause disruption to the community even if it is non-pathological in the individual (Blair, 1991, p. 59). The causes of this can be manifold: injuries, accidents, separation from home, eroding job satisfaction, and deaths of fellow crew members all potentially contributing to the onset of depression (Pierce, 1991, p. 129). The way communities deal with this psychological dysfunction requires further study, because coping strategies are not always adequate (Blair, 1991, p. 62) and more strategies are necessary. Furthermore, these two ICE can inform each other when it comes to re-entry: preparing the crew members and their families for the post-mission reunion (Pierce, 1991, p. 130); and preparing the crew for their return from Antarctica's highly structural schedules to daily living to an inevitably more chaotic life in a larger society (Oliver, 1991, p. 223); most relevantly, the Scott-Amundsen South Pole Station has been deemed a suitable space analogue because of the harsh conditions at the geographical South Pole. It is also optimal for research into human adaptation, man-machine interactions, and small group dynamics (Levesque, 1991, p. 15).

Carrère et al. (1991, p. 236) point out that as a non-laboratory environment, Antarctica allows researchers to control for many extraneous variables which influence other field work. An interesting common stressor across all ICE is the operating agency of the respective research station (Lugg, 1991, p. 40). Because both parties, the personnel at the station and the authority, may feel that they are the only ones to judge a problem adequately, and thus choose a solution (Blair, 1991, p. 62). Researching this interaction in one ICE should yield relevant information across others. Similarly, Antarctic evidence can be used to understand terrestrial occupations where people spend time in remote areas better. In addition to the above example, knowledge of psychological phenomena during ICE missions could be useful for topographers, architects, and law enforcement personnel, who spend long periods of time apart from their families (Bechtel & Berning, 1991, p. 264). Additionally, the same environment may lead to very different experiences in different people; or the same environment can provide different experiences for the same person - and different environments may provide similar experiences for different people (Suedfeld, 1991a, p. 138). The relationship between environment and behaviour should be viewed as an interaction effect, rather than a main effect (Suedfeld, 1991a, p. 137). None of the environmental stressors act alone, they are interactions between chronic conditions and acute events (Carrère et al., 1991, p. 234). This suggests that the study of psychological reactions to ICE is worthwhile, whether the goal is to extrapolate through comparison or to learn more about human experiences of them and our capacity to adapt.

What to study in ICE?

There are many suggestions of what to study in ICE. After an overt case of psychosis during the International Geophysical Year (1957-58) severely disrupted the team's functioning, psychological screenings prior to deployment were established (Blair, 1991, p. 60). Similarly, old Antarctic sojourners supply an abundance of anecdotal evidence for insomnia, depression, alcoholism, and failure to re-adapt to home, but there has been little research into this (Blair, 1991, p. 59). The proposed focus for future research has been how to help people adapt, how to offer coping strategies in cases of maladaptation, and looking at group selection rather than individual selection, because some individuals pose threats against the whole group's well-being (Levesque, 1991, p. 17). The priority should be placed on finding better predictors of adaptation, developing stimulation techniques to prevent boredom, and on conceiving useful group leadership training courses (Levesque, 1991, p. 19).

During the mission, it is important to study how team members spend their free time, which may play a role in reducing group tensions (Pierce, 1991, p. 128). Further priority should be placed on male-female interactions, psychological peer support systems, self-help programmes for stress management, and crisis management techniques (Pierce, 1991, p. 132). Because the environment is filtered through each person's physiological and psychological information processing system, it exerts an indirect influence. This means that in addition to their behaviour, their perception of the environment needs to be measured (Suedfeld, 1991, p. 137-138). When studying ICE, it is important to include assessments before, during, and after the ICE mission (Suedfeld, 1991, p. 143). In order to better understand the background against which the studies cited in Section 1.4 have been conducted, the physical and social conditions at both poles will be outlined briefly.

1.2 Antarctica

As the highest, coldest, driest, and windiest of Earth's continents (Palinkas, 1990), Antarctica poses a challenging environment. The Antarctic plateau is an icy desert with constant blizzards where the temperature ranges from -25° Celsius to -80° Celsius (Cornelius, 1991, p. 9). In this harsh environment, the largest surviving land animal is a mite (Cornelius, 1991, p. 9) and there is no indigenous population; nevertheless, humans have been living on the continent since World War II (Palinkas, 1989). There are two civilian settlements – Argentina's Esperanza Base (est. 1952) and Chile's Villa Las Estrellas (est. 1984) – and 47 permanent research bases, operated by 20 nations (Palinkas & Suedfeld, 2008) which are inhabited purely by scientists and support personnel, see Figure 1.1. According to the Antarctic Treaty, none of these nations own the continent, national presence there may be established for scientific purposes only (Cornelius, 1991, p. 9).

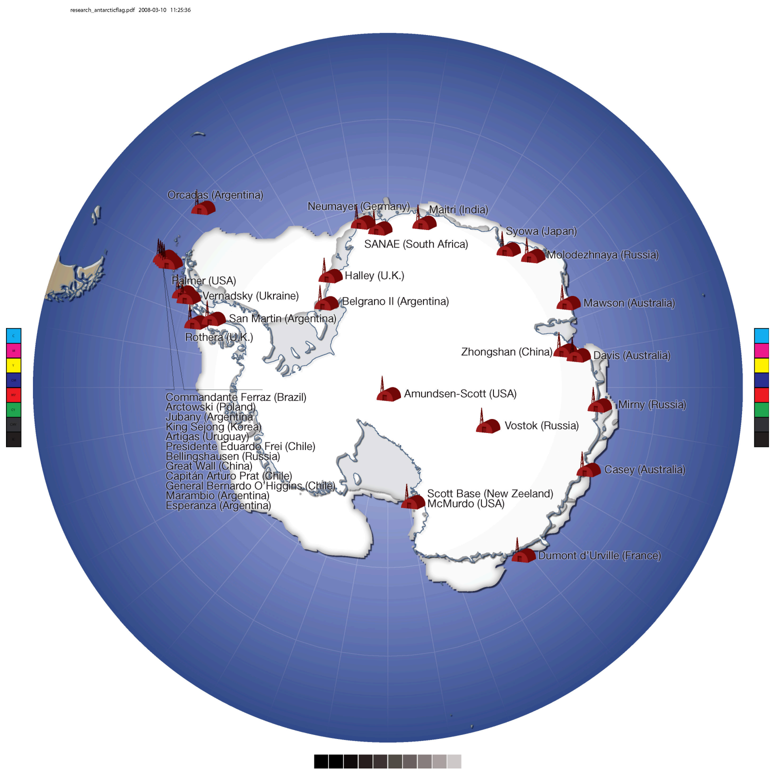

Figure 1.1: The Major Research Stations in Antarctica.

The majority of behavioural research has been reported from McMurdo, South Pole Amundsen-Scott and Palmer Stations, all of which are U.S. American. A minority of studies have reported from Maitri (Indian), Shōwa (Japanese), Dumont d'Urville (French), Halley or Rothera Stations (both British). One major French-Italian research station, Concordia (75°S, 123°E), is missing from this map.

These bases require complex technological operations to ensure survival in this hostile climate; this can mean total physical isolation for nine to twelve months (Lugg, 2005). Stressors from the physical environment include dangerous crevasses, blizzards, and continuous darkness (Guly, 2012; Palinkas & Suedfeld, 2008). However, technologies and subsequently physical living conditions have continuously been improving (Gunderson, 1968). To illustrate this further: during Sir Douglas Mawson's Australasian

Antarctic Expedition (AAE, 1911-1914), 18 men shared a single hut which was a 7.3x7.3 meter rectangle, and served as bedroom, kitchen, dining room and living room during their winter at Cape Evans (Roberts, 2014, p. 126). In 1968, Gunderson described the biggest of the U.S. stations, McMurdo, as having numerous recreational facilities for golf and bowling, as well as a nuclear reactor to provide heat and distilled water, the latter was deactivated in 1973. For the past 25 years, McMurdo has resembled a small town, with hotels, gyms and cinemas, as described by Palinkas (1989). In the 21st century, McMurdo provides internet connection for its staff to communicate with their loved ones at home, while extreme temperatures of up to -73° Celsius still confine the staff indoors (Palinkas, Johnson, & Boster, 2004). Compared to the *Heroic Age of Antarctic Exploration* (1897-1917, Roberts, 2014, p. 21), when expedition members had to wait for months or even years to hear from their families, this is a relative luxury. It is also a mixed blessing, as hearing from home may shift their perceived locus of control from external to internal. If expedition members cannot communicate with their families, there is nothing they can do in emergencies and nothing which can be expected of them, meaning they perceive the locus of control as external (Blair, 1991, p. 62). With the improvement of modern communications, sojourners may feel that control of undesirable events at home may lie with them. Frequently, they seem to worry about their partner's ability to cope with the distance, rather than their fidelity (Rivolier, Cazes, & McCormick, 1991, p. 289).

These improvements in the comfort of living quarters and the homeward communications mean that presently, Antarctic mental health is influenced more strongly by the social environment than the physical one (Bhatia & Pal, 2012). As mentioned in Section 1.1, this social environment is characterised by lack of privacy, boredom, sexual and emotional deprivation, and forced social interaction with little opportunity to escape unpleasant individuals or situations (Palinkas, 1990). Especially in Antarctica, where one's workplace may become the most private space available (Blair, 1991, p. 62), social stress and its inevitability may even prompt people to plot fellow crewmembers's deaths (Levesque, 1991, p. 16). Additionally, even the modern stations' structural integrity may easily be compromised in a fire, as mentioned above, requiring constant caution and a survival mentality (Levesque, 1991, p. 16). This psychological stress, combined with polar night, has severe consequences on psychological well-being, crew functioning and performance, as outlined in Section 1.4. All this shows that Antarctica remains an extreme ICE, even today under more comfortable conditions than ever.

1.3 The High Arctic

The first, and foremost difference between the Arctic and the Antarctic is that the former is not a continent. The "Arctic Eight" countries (A8) each hold landmass within the Arctic Circle ("Coming in from the Cold", 2006), the southernmost latitude of the Northern Hemisphere where the sun may remain continuously above or below the horizon. The Arctic Circle shifts north by about two degrees over 40,000 years, depending on the Earth's axial tilt and the tidal forces of the moon. The A8 are Russia, Canada, Denmark (including Greenland and the Faroe Islands), the United States of America, Norway (including the Svalbard and Jan Mayen archipelago), Finland, Sweden and Iceland (Grímsey Island). As such, it is difficult to outline comprehensive weather conditions, the way it has been done for the Antarctic continent. The Arctic is climatically milder and has more vegetation than Antarctica (Steel, Suedfeld, Peri, & Palinkas, 1997). Figure 1.2 shows an outline of Arctic geography and the different stations.

Figure 1.2: Major Arctic Research Stations.

Here, it is distinctive that there is no station at the geographical North Pole because the stations are built on landmass whilst the pole is covered in sea ice. The stations closest to the North Pole are Eureka (Canada, 79°N, 85°W), Ny-Ålesund (co-operated between France, Germany, Italy, Norway, Japan and the UK, 78°N, 11°O), and Hornsund (Poland, 77°N, 15°E). This map also shows that many Arctic research stations are relatively close to further human settlements because the countries in and around the Arctic have native inhabitants and indigenous peoples. This does not necessarily mean that these stations are easy to reach for evacuation purposes though. Map created by Hugo Ahlenius for GRID-Arendal, available at: http://www.grida.no/polar/ipy/2843.aspx

Table 1.1 contains a list of potential dangers associated with Arctic work, adapted from Box 6.1 of INTERACT (2014, p. 104).

Table 1.1

Dangers in the Arctic.

General Risks

1. Distance to medical facilities
2. Medication (for medically dependent personnel)
3. Differences between abilities and expectations

Transport Risks

1. Inexperience and lack of attention
2. Aircrafts and helicopter accidents/mechanical failures
3. Boat accidents/mechanical failures
4. Other vehicle accidents/mechanical failures

Risks in the Field

1. Inexperience, differences between abilities and expectations
2. Fatigue
3. Hypothermia and other cold-related injuries
4. Remoteness
5. Camping, tents, huts: carbonmonoxide from heaters, wildlife and similar
6. Glacier field work
7. Glacial lake outbursts/floods
8. Avalanches
9. Working below cliffs
10. River crossings
11. Climbing
12. Polar bears
13. Rifles/ammunition
14. Fires

Risks at the Station

1. Fuel and chemical storage/usage
2. Manual handling of heavy goods
3. Laboratory work
4. Workshops and equipment use
5. Electricity
6. Kitchen
7. Fire

Field work is integral to polar expeditions, and has the most risks.

This research was conducted on Spitsbergen Island, in the Svalbard archipelago and therefore, the weather conditions for this part of the Arctic will be detailed, including diagrams of the the Polish Polar Station, Hornsund (77°0’0” North, 15°33’0” East).

Spitsbergen Island, Svalbard

The coldest average temperature in 2015 was recorded in February, at -13° Celsius, with July 2015 being the warmest month at +7.7° Celsius. The windiest month was March 2015, at 7.1 m/s average windspeed (Meterologisk, 2015). Climatically far less hostile than the Antarctic, Svalbard presents humans with different environmental threats. Similar to Antarctica, crevasses are a concern when travelling. However, polar bears (ursus maritimus) pose a more immediate threat to human life and precautions must be taken even in settlements. Examples of such precautions are that no-one may leave settlements without the company of a person carrying and trained to use guns of a sufficient size, and that no food waste may be left behind anywhere in case it attracts the bears (Norwegian Polar Institute, 2005; INTERACT, 2014, p.135).

Socioculturally, the Kingdom of Norway has held full sovereignty over Svalbard since the ratification of the Svalbard Treaty in 1920. According to this treaty, no military presence may be established on the archipelago, but all countries which have ratified the treaty may hunt, fish, trade or mine there (Sysselmannen, 2012). In this respect, the Svalbard Treaty resembles the Antarctic Treaty. Norway has established a Governor of Svalbard (“Sysselmannen på Svalbard” or just “Sysselmannen”), whose office in Longyearbyen, the archipelago’s capital, ensures that the strict environment protection regulations are enforced. Anyone coming to the island has to register with them. Svalbard has a population of roughly 3000 people, including 500 Russian mine workers (Statistics Norway, 2015), which means it has permanent inhabitants, opposed to Antarctica.

There are numerous research stations on the archipelago, and only the most important ones will be highlighted here. In Ny-Ålesund, there is a settlement of stations run by several countries, including but not limited to France, Germany and the United Kingdom (UK). This settlement has an airfield, which allows researchers to travel back and forth more easily than in the Antarctic (INTERACT station catalogue, 2012). Conditions at different research facilities may vary considerably (INTERACT station catalogue, 2012, p. 51). The present study took place at Svalbard's other major research facility: the Polish Polar Station, Hornsund. Hornsund lies approximately 250km south of Ny-Ålesund and is much less accessible: further details can be found in Section 2.1.

1.4 Six Decades of Polar Psychology

> "While our technology allows us to live and work in such extreme environments, it is what people do there and how they live there, that are truly important."
> – Levesque (1991, p. 20)

The stressors from the Antarctic environment – dangerous crevasses, blizzards, and continuous darkness in austral winter (Guly, 2012; Palinkas & Suedfeld, 2008)– also hold true for the Arctic winter, even though its blizzards are fewer and weaker and its temperatures are warmer than the Antarctic ones (Palinkas, 1989, 1991b). However, while Antarctica's largest land animal is a mite (Cornelius, 1991, p. 9) – penguins are considered aquatic birds – the Arctic is home to polar bears, which pose a considerable threat to human life (Norwegian Polar Institute, 2005). The presence of polar bears requires crews to handle large-calibre fire arms (Norwegian Polar Institute, 2005). This distinctive feature of the Arctic is entirely absent in Antarctica, with possibly grave implications for the psychological status of the people living in this ICE, given that some Antarctic ICE crews have admitted plotting unpopular team members's deaths during the isolation period (Levesque, 1991, p. 16).

As outlined previously, these hostile physical surroundings, combined with the confinement indoors with strangers and isolation from one's family produce uncomfortable proximity with unfamiliar people, as well as unwanted changes in one's personal thoughts, feelings, and behaviour (Blair, 1991, p. 58). As such, the social environment can exert more influence on mental health than the harsh physical environment (Bhatia & Pal, 2012).

We conclude that all the Antarctic stressors are present in the Arctic too, even though they may be less expressed (e.g. weaker blizzards, warmer temperatures). There are roughly equal numbers of stations in both regions offering possibilities for Arctic insight; but the presence of dangerous predators constitutes a psychologically unexplored threat to Arctic crews' survival. This may contribute to a different psychological experience of Arctic crews, compared to Antarctic ones. However, Palinkas (1990) and Suedfeld

(1991) have pointed out that the Arctic has received less attention when it comes to ICE research. This literature review aims to compare and contrast the evidence between Antarctic and Arctic stations to establish any similarities and differences in their effects on human functioning as well as similarities and differences in terms of research frequency.

For this purpose, we conducted two systematic literature searches. The first focused on Antarctica, to see what psychological or cognitive changes have been observed there to date; the second one repeated this for Arctic crews.

1.4.1 Literature Acquisition Methodology

Search Technique

The aim of this search was to find literature on mood, mental health and cognitive performance at Antarctic and Arctic research stations, in camps or on traverse missions. Literature searches were stratified for easier comparison. Given the particular focus of this review on potential differences between the Artic and Antarctica, we confined our research to non-native scientists who travel to the poles to conduct their work. This meant an exclusion of papers examining the indigenous populations or mine workers: accordingly, we added the exclusion criteria “NOT indigenous NOT Inuit NOT Nenet” to the search term “Arctic”. We also added “NOT animal” to exclude papers about Arctic fauna. Before excluding these terms, the “Arctic” results exceeded 20000 publications. This exclusion was not necessary with the “Antarctica” search term because this continent does not have any indigenous peoples and few animals.

Systematic psychological research was first initiated at US stations during the International Geophysical Year 1957-58 (IGY, Gunderson, 1973, p. 353) that is why we limited our search time frame from 1955 to 2016. We used the following databases on July 29, 2016:

1. Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations
2. Ovid MEDLINE(R) 1946 to Present
3. PsycINFO 1806 to July Week 3 2016
4. Your Journals@Ovid
5. PsycARTICLES Full Text
6. Global Health 1910 to 2016 Week 29
7. Ovid Medline (R) Ahead of Print, July 28, 2016.

Figure 1.3 conveys our search strategies graphically.

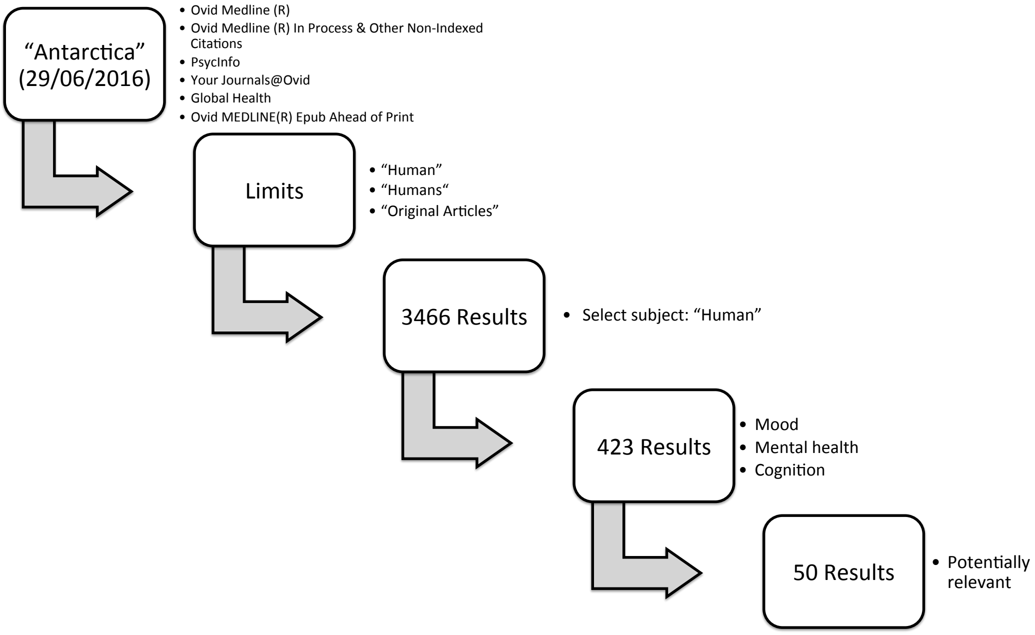

Figure 1.3. The Stratification and Results of the Systematic Literature Search.

First, the search term "Antarctica" was entered into the data bases listed in Figure 1.3. Before the search was run, the boxes with the limiters "Human", "Humans", and "Original Articles" were ticked to indicate that only original articles investigating humans were of interest. 3466 results were found, to reduce this searchable number the subject "human" was selected. This presented 423 possible papers whose titles and abstracts were scanned to see if mood, mental health, and cognition were among the investigated variables. After this initial scan, 50 papers were considered potentially relevant.

The two searches produced a total of 2851 publications to select from for our systematic review, with Antarctic literature contributing 14.84% (n=423) of the papers, compared to the 84.85% (n=2419) of results coming from the Arctic literature. Of the 423 Antarctic publications, 50 were considered potentially relevant compared to 35 out of 2419 Arctic publications. These 85 are the potentially relevant results whose titles and abstracts were scanned to identify their relevance.

The total amount of studies found was 2851, 14.84% (n=423) of which were conducted in Antarctica, as compared to 84.85% (n=2419) studies which took place in the Arctic. Hence, before any selection occurred there was an abundance of Arctic literature focused on humans, compared to Antarctic literature.

The Selection Process

We excluded all those papers that did not match these criteria:

1. Original scientific study (no reviews, editorials, historical papers),
2. Arctic or Antarctic data focus,

a. Focus on visiting scientists, not the local population or shift-workers in mines,

3. Psychological variables such as cognition, mood or mental health.

Although the main search was conducted on July 29, 2016, we re-ran the same search for the period between July 29, 2016 and May 11, 2017, before submitting this review; two new papers surfaced. Altogether, 36 publications were selected for review.

To be as inclusive and comprehensive as possible we have reviewed 19 further suitable studies in the Antarctic region (Bhatia & Pal, 2012; Butcher & Ryan, 1974; Chen, Wu, Li, Zhang, & Xu, 2016; Décamps & Rosnet, 2005; Gunderson, 1968; Khandelwal, Bhatia, & Mishra, 2015; Leon, 1991; Otani, Ohno, Shimoeda, & Mikami, 2004; Palinkas, 1991b; Palinkas, Houseal, & Rosenthal, 1996; Peri, Scarlata, & Barbarito, 2000; Premkumar, Sable, Dhanwal, & Dewan, 2013; Rosnet, Scanff, & Sagal, 2000; Steel, 2001; Steel et al., 1997; Taylor, 1969; Ursin et al., 1991; Weiss, Suedfeld, Steel, & Tanaka, 2000; Wood, Hysong, Lugg, & Harm, 2000) that were not found by the search. Only one of these (Rosnet et al., 2000) did not have “Antarctic” or “Antarctica” in its title, abstract and keywords which is presumably why it was not found by our search procedure. Why the other papers were not found by the search engine is a mystery to us. This brings the total number of included papers to 55 but the number of Arctic papers remains at six because we could not find any additional research.

This substantiates Palinkas’ (1990) and Suedfeld’s (1991b) claims that Arctic ICE have not been studied as extensively as Antarctic crews: Arctic literature contributed 10.91% (n=6) of the evidence and Antarctic literature supplied 89.09% (n=49). So there are approximately nine times more publications on Antarctic ICE crews. To the best of our knowledge, this is the first review demonstrating this. The exact reasoning behind the exclusion of individual papers can be found in Table A1 of Appendix A at the end of this thesis while the list of the selected papers is presented in Table 1.2 below.

Table 1.2

The Authors and Titles of all 85 Publications that Were Potentially Relevant to Cognition, Mood, Mental Health or Personality, By Search Term.

"Antarctica"	**"Arctic"**
Albretsen, C. S. (2003). Hjalmar Johansens selvmord.▽	Akerblom, H. K. (1993). Human exposure to environmental hazards in the Arctic.▽
Bell, J., & Garthwaite, P. H. (1987). The psychological effects of service in British Antarctica: a study using the General Health Questionnaire.	Albretsen, C. S. (1996). [Roald Amundsen--a study of personality].
Bhargava, R., Mukerji, S., & Sachdeva, U. (2000). Psychological Impact of the Antarctic Winter on Indian Expeditioners.	Albretsen, C. S. (2003). [The challenges for physicians on polar expeditions around the year 1900].◎
Bhatia, A., Malhotra, P., & Agarwal, A. K. (2013). Reasons for medical consultation among members of the Indian Scientific Expeditions to Antarctica.	Alm, N. O. (1987). Health services in Longyearbyen, Svalbard/Spitsbergen.
Corbett, R. W., Middleton, B., & Arendt, J. (2012). An hour of bright white light in the early morning improves performance and advances sleep and circadian phase during the Antarctic winter.	Andersen, K. (1968). [The biological adaptability of man].◎
Grant, I., Eriksen, H. R., Marquis, P., Orre, I. J., Palinkas, L. A., Suedfeld, P., … Ursin, H. (2007). Psychological Selection of Antarctic Personnel: The "SOAP" Instrument.	Andersen, T. (1979). Ill health in two contrasting societies, particularly non-psychiatric morbidity among those with a psychiatric diagnosis.
Gunderson, E. K. E. (1968). Mental Health Problems in Antarctica. R	Anthi, P. R. (1999). Roald Amundsen: a study in rivalry, masochism and paranoia.
Harrison, A. A., Clearwater, Y. A., & McKay, C. P. (1989). The human experience in antarctica: Applications to life in space. R	Arctic research: what, why, how? (1988).
Ikegawa, M., Kimura, M., Makita, K., & Itokawa, Y. (1998). Psychological studies of a Japanese winter-over group at Asuka Station, Antarctica.	Bishop, S. L., Grobler, L. C., & Schjoll, O. (2001). Relationship of psychological and physiological parameters during an Arctic ski expedition.
Lamberth, P. G. (2000). Death in Antarctica.	Brennen, T., Martinussen, M., Hansen, B. O., & Hjemdal, O. (1991). Arctic Cognition: A Study of Cognitive Performance in Summer and Winter at 69 Degrees North.
Law, P. (1960). Personality problems in Antarctica.	Cochrane, J. J., & Freeman, S. J. (1989). Working in arctic and sub-arctic conditions: mental health issues.
Lugg, D. J. (1988). Antarctica--lessons for health care planning and delivery to circumpolar populations. R	Coming in from the cold. (2006).

“Antarctica”	“Arctic”
Lugg, D. J. (1990). Humans on ice: a review of research on those living in Antarctica since IGY 1957-58 R	Goldman, G. S. (1964). OBSERVATIONS OF A PSYCHIATRIC HOSPITAL NORTH OF THE ARCTIC CIRCLE.▽
Lugg, D. J. (2005). Behavioral Health in Antarctica: Implications for Long-Duration Space Missions. R	Griofa, M. O., Blue, R. S., Cohen, K. D., & O’Keeffe, D. T. (2011). Sleep stability and cognitive function in an Arctic Martian analogue.
McCormick, I. A., Taylor, A. J. W., Rivolier, J., & Cazes, G. (1985). A Psychometric Study of Stress and Coping during the International Biomedical Expedition to the Antarctic (IBEA).	Hanlon, J. J. (1972). Interaction between man and the Arctic environment. Past, present, and prospective.
Mervis, J. (2009). POLAR SCIENCE: A Death in Antarctica.	Holyoke, E. A. (1994). Three physician Explorers.▽
Ohno, G., Watanabe, K., Okada, Y., & Higuchi, K. (2012). Practical experience of telehealth between an Antarctic station and Japan. R	Huntington, H. P. (2011). Arctic science: The local perspective.
Olson, J. J. (2002). Antarctica: a review of recent medical research. R	Jacobsen, B. K., Hasvold, T., Hoyer, G., & Hansen, V. (1995). The General Health Questionnaire: how many items are really necessary in population surveys?
Palinkas, L. (2001). Circannual pattern of hypothalamic–pituitary–thyroid (HPT) function and mood during extended antarctic residence.	Kintisch, E. (2015). Don’t mess with the bears.
Palinkas, L. A. (1987). A Longitudinal Study of Disease Incidence Among Antarctic Winter-Over Personnel.	Klen, T. (1992). Accidents in the Arctic. A psychological point of view.
Palinkas, L. A. (1989). Sociocultural influences on psychosocial adjustment in Antarctica. R	Korolenko, T. P., Bochkareva, N. L., & Sokolov, V. P. (1979). [Psychophysiological and social aspects of adaptation in the Far North].◎▽
Palinkas, L. A. (1990). Psychosocial effects of adjustment in Antarctica - Lessons for long-duration spaceflight. R	Krivoschekov, S. G., & Shishkina, T. N. (1998). Psycho-physiological mechanisms of adaptation of rotation personnel in Arctic regions.
Palinkas, L. A. (2003). The psychology of isolated and confined environments: Understanding human behavior in Antarctica. R	Lathan, C., Spira, J. L., Bleiberg, J., Vice, J., & Tsao, J. W. (2013). Defense Automated Neurobehavioral Assessment (DANA)-psychometric properties of a new field-deployable neurocognitive assessment tool.
Palinkas, L. A., Cravalho, M., & Browner, D. (1995). Seasonal variation of depressive symptoms in Antarctica.	Leon, G. R., & Scheib, A. (2007). Personality influences on a two-man Arctic expedition, impact on spouse, and the return home.
Palinkas, L. A., Glogower, F., Dembert, M., Hansen, K., & Smullen, R. (2004). Incidence of Psychiatric Disorders after Extended Residence in Antarctica.	McNabb, S. (2004). Arctic research at three levels.
Palinkas, L. A., Gunderson, E., Holland, A. W., Miller, C., & Johnson, J. C. (2000). Predictors of behavior and performance in extreme environments.	Palinkas, L. A. (2001). Mental and cognitive performance in the cold. R

“Antarctica”	“Arctic”
Palinkas, L. A., Gunderson, E. K. E., Johnson, J. C., & Holland, A. W. (2000). Behavior and performance on long-duration spaceflights: Evidence from analogue environments. R	Palinkas, L. A. (2010). Coming out of the cold and stepping into the light: human adaptation in high latitude environments.
Palinkas, L. A., & Houseal, M. (2000). Stages of Change in Mood and Behavior During a Winter in Antarctica.	Palinkas, L. A., & Suedfeld, P. (2008). Psychological effects of polar expeditions. R
Palinkas, L. A., Houseal, M., & Miller, C. (2000). Sleep and mood during a winter in Antarctica.	Palinkas, L. A., Suedfeld, P., & Steel, G. D. (1995). Psychological functioning among members of a small polar expedition.
Palinkas, L. A., Houseal, M., & Rosenthal, N. (1996). Subsyndromal Seasonal Affective Disorder in Antarctica.	Parkinson, A. J. (2011). The international polar year: continuing the arctic human health legacy.
Palinkas, L. A., Johnson, J. C., & Boster, J. S. (2004). Social support and depressed mood in isolated and confined environments.	Parkinson, A. J. (2013). The Arctic Human Health Initiative: a legacy of the International Polar Year 2007-2009.
Palinkas, L. A., Johnson, J. C., Boster, J. S., Rakusa-Suszczewski, S., Klopov, V. P., Fu, X. Q., & Sachdeva, U. (2004). Cross-cultural differences in psychosocial adaptation to isolated and confined environments.	Popefe, & Rogers, T. A. (1968). Some psychiatric aspects of an arctic survival experiment. A clinical note on thirteen scientists.
Palinkas, L. A., Reedy, K. R., Shepanek, M., Reeves, D., Samuel Case, H., Van Do, N., & Lester Reed, H. (2010). A randomized placebo-controlled clinical trial of the effectiveness of thyroxine and triiodothyronine and short-term exposure to bright light in prevention of decrements in cognitive performance and mood during prolonged Antarctic residence.	Steine, S., Steine, K., Sandbaek, G., & Roseth, A. G. (2003). [A polar expedition in challenging circumstances--experiences and psychological reactions]. ©
Palinkas, L. A., Reedy, K. R., Shepanek, M., Smith, M., Anghel, M., Steel, G. D., … Reed, H. L. (2007). Environmental influences on hypothalamic–pituitary–thyroid function and behavior in Antarctica.	Suedfeld, P. (1998). What can abnormal environments tell us about normal people? Polar stations as natural psychology laboratories. R
Palinkas, L. A., Reedy, K. R., Smith, M., Anghel, M., Steel, G. D., Reeves, D., … Reed, H. L. (2007). Psychoneuroendocrine effects of combined thyroxine and triiodothyronine versus tyrosine during prolonged Antarctic residence.	Tafforin, C. (2015). Confinement vs. isolation as analogue environments for Mars missions from a human ethology viewpoint.
Reed, H. L., Reedy, K. R., Palinkas, L. A., Van Do, N., Finney, N. S., Case, H. S., … Thomas, J. (2001). Impairment in Cognitive and Exercise Performance during Prolonged Antarctic Residence: Effect of Thyroxine Supplementation in the Polar Triiodothyronine Syndrome.	
Reed, H. L., Silverman, E. D., Shakir, K. M. M., Dons, R., Burman, K. D., & O’Brian, J. T. (1990). Changes in Serum Triiodothyronine (T 3) Kinetics after Prolonged Antarctic Residence: The Polar T 3 Syndrome.	

"Antarctica"	"Arctic"
Rivolier, J., Gueriot, J. C., & Perrier, F. J. (1967). [Study of fatigue and its physiopathologic consequences in subjects spending the winter in Antarctica]. ◎	
Sandal, G. M. (1998). The effects of personality and interpersonal relations on crew performance during space simulation studies. R	
Sandal, G. M. (2000). Coping in Antarctica: Is it possible to generalize results across settings?	
Schmidt, L. L., Wood, J., & Lugg, D. J. (2004). Team Climate at Antarctic Research Stations 1996–2000: Leadership Matters.	
Schmidt, L. L., Wood, J., & Lugg, D. J. (2005). Gender differences in leader and follower perceptions of social support in Antarctica.	
Soroko, S. I., Matusov, A. L., & Sidorov YuA, null. (1984). Human adaptation to extremal conditions in Antarctica.	
Stuster, J. (1998). Human and team performance in extreme environments: Antarctica. R	
Suedfeld, P., & Weiss, K. (2000). Antarctica: Natural Laboratory and Space Analogue for Psychological Research. R	
Tafforin, C. (2004). Ethological analysis of a polar team in the French Antarctic station Dumont d'Urville as simulation of space teams for future interplanetary missions.	
Tanaka, M., & Watanabe, S. (1994). Overwintering in the antarctica as an analog for long term manned spaceflight.	
Taylor, A. J. W. (1998). Psychological adaptation to the polar environment. R	
Wood, J., Lugg, D. J., Hysong, S. J., & Harm, D. L. (1999). Psychological Changes in Hundred-Day Remote Antarctic Field Groups.	
Xu, C., Zhu, G., Xue, Q., Zhang, S., Du, G., Xi, Y., & Palinkas, L. A. (2003). Effect of the Antarctic environment on hormone levels and mood of Chinese expeditioners. International Journal of Circumpolar Health, 62(3), 255–267.	

Notes: ◎ denotes publications not in English

▽ denotes publications without an abstract

R denotes publications that are reviews

1.4.2 Analysis and Review of the Evidence

We begin our evaluation by introducing two important concepts in polar psychology: *Winter-Over Syndrome (WOS)* and the *Polar T3 Syndrome (PT3)* which have been documented frequently at research stations (see below). We will also discuss their causes and people's coping strategies. For station locations, please refer back to Figures 1.1 and 1.2 and bear in mind that the higher any station's latitude, the longer its polar night will be. Finally, we will present evidence from traverse expeditions.

The Winter-Over Syndrome (WOS)

The term WOS was first introduced by Strange & Youngman (1971). It presents with increased sleep disruption (insomnia, fatigue and/or nightmares), anger, tension, anxiety, depression, memory and concentration problems; these symptoms are worst at mid-winter (Palinkas, Cravalho, & Browner, 1995; Palinkas, Johnson, & Boster, 2004; Palinkas & Suedfeld, 2008). Although they decline after mid-winter, they only reach pre-winter levels when the team members return home, where full recovery occurs in almost all cases (Palinkas, Cravalho, et al., 1995). These fluctuations in mood resemble *sub-syndromal Seasonal Affective Disorder (S-SAD)* and thus do not necessitate psychiatric interventions (Palinkas, 2003; Palinkas et al., 1996).

The historical prevalence of the WOS can be seen from Law (1960) who described the symptoms of the WOS in Australian crews eleven years before Strange and Youngman (1971) officially named the syndrome: at Mawson Station, men's morale is high at the beginning of the isolation but deteriorates after sunset. Morale rises again when the sun rises. Similarly, Gunderson (1968) showed that 60% of all Americans at the seven investigated stations (McMurdo, Hallet, Eights, Byrd, Palmer, Plateau, Amundsen-Scott) reported feeling blue. Other frequent symptoms included feeling lonely, worried and irritable at all times as well as problems with concentration. An increase in lethargy, boredom, sleep issues and irritability over the winter was confirmed in New Zealand's Antarctic crews by Taylor (1969). Bell and Garthwaite (1987) documented the WOS in British personnel at Rothera, whose sleep disruption, anxiety, depression and social dysfunction worsened over winter. This seems common: Palinkas, Cravalho, et al., (1995) participants showed more and stronger symptoms of depression in winter, compared to summer. Tellingly, three of Bell and Garthwaite's (1987) twelve participants had to be evacuated because of psychological complications. Bell and Garthwaite (1987) assumed that they suffered from pre-existing, chronic psychological disturbances that had worsened because of their Antarctic residence. They based this assumption on the observation that one of the men did not make a full recovery one year after his Antarctic experience. There is only one study (Butcher & Ryan, 1974) which documented no seasonal psychological changes at all at Amundsen-Scott, and no differences to a control group.

Indeed, Palinkas, Glogower, Dembert, Hansen and Smullen (2004) found out that after polar night, 5.2% of the American sojourners presented with psychiatric symptoms so severe that that they justified one or more psychiatric diagnoses. These diagnoses included mood disorders, sleep disorders, adjustment disorders, substance-abuse and personality disorders. Mood, sleep and adjustment disturbance are all in accordance with the WOS. Substance abuse is not listed as a symptom of the WOS but it may occur simultaneously. The personality disorders in question were schizoid personality disorder, characterised by lack of interest in social relationships, a tendency towards a solitary lifestyle, secretiveness, emotional coldness, and apathy; and dependent personality disorder, characterized by a pervasive psychological dependence on other people for meeting their emotional and physical needs (American Psychiatric Association, 2000). The personnel underwent psychiatric screenings before deployment; no personality disorders were observed at this point. The subclinical expressions of these personality disorders are anxiety, tension, and overall social dysfunction, all of which appear over the course of polar missions (Bell & Garthwaite, 1987; Palinkas & Houseal, 2000). The dependence on others for meeting one's personal emotional and physical needs was identified as highly problematic in polar settings as crew members became increasingly dissatisfied with the support they received from loved ones at home and little support was available from co-workers (Palinkas, Johnson, & Boster, 2004). This may have contributed to their worsened emotional state.

In the Arctic, Cochrane and Freeman (1989) provide insight into the WOS even though they do not employ this term. Their meteorologists at the isolated Canadian outposts Frobisher Bay, Resolute Bay, Eureka, Mould Bay and Alert describe an impairment of memory and concentration called Arctic inertia over the winter, frequently presenting itself with inactivity or apathy. They also observed “cabin fever” among their participants: the irritability and depression rooted in cramped living quarters. Though labelled differently, these symptoms are essentially identical to the Antarctic ones.

So far, it is clear that the WOS is present in almost the entire polar anglosphere: American, Australian, British and Canadian crews have consistently reported matching symptoms from the 1960s to the early 2000s, at both poles. But is it equally prevalent in other cultures? The next section will examine this question.

The WOS Across Cultures

In terms of non-English speaking Western cultures, Sandal (2000)reported on Scandinavian station personnel, without specifying their nationalities. His participants became very stressed from interpersonal interactions and reported higher anxiety levels. The strongest decline in well-being occurred in the third quarter of the mission rather than at the midpoint which Sandal (2000) interpreted as the third quarter phenomenon (TQP), rather than the classic WOS. The TQP affects crews on any time-limited, stressful mission – not just polar ICE; it presents with a third-quarter decline because participants lament how much time their mission has left (Bechtel & Berning, 1991). Décamps and Rosnet (2005) also documented the TQP, rather than the WOS at the French Dumon d’Urville Station, Antarctica: their participants showed most stress symptoms at the middle of their winter isolation rather than at the middle of their overall mission. Italian men who reported on their mood before and after spending up to five months in Antarctica showed a small increase in confusion and fatigue as well as a decrease in vigor at the mission mid-point (Peri et al., 2000). However, these Italians did not winter-over. In a New Zealand winter team, Steel (2001) suggested that the TQP manifests with a very slight increase in depression or anger.

With regard to non-Western cultures, Tanaka and Watanabe's (1994) participants at Japan's Shōwa Station exhibited heightened depression, anxiety, hostility and insomnia increased after the beginning of the winter isolation, as is consistent with the WOS. All participants gravitated towards maladaptation, especially the logistics personnel. Tanaka and Watanabe (1994) note that this may be because the logistics personnel did not have to undergo the same strict selection process as the scientists. They suggest that Japan's selection techniques of the early 1990s needed reformation to avoid serious psychological problems at their Antarctic stations.

Ikegawa, Kimura, Makita, and Itokawa (1998) found a different pattern from Tanaka and Watanabe (1994) that nonetheless resembled the WOS. Ikegawa et al.'s (1998) Japanese participants at Shōwa Station experienced a peak in morale after the station became isolated in February similar to Law's (1960) Australians. But contrastingly, their morale remained very high until the mid-winter day in July when it declined. Over three expeditions to Asuka Station, Weiss et al. (2000) found levels of anxiety that resembled those of Western sojourners. Otani et al. (2004) analysed medical reports from 1236 Japanese at Shōwa from 1956 to 2001 and concluded that only 2% of consultations were due to psychiatric complications in polar night. Whether the recommendations to improve the Japanese selection techniques by Tanaka and Watanabe (1994) were implemented prior to these studies is unknown. But it is clear that the variation is not just intercultural but also intracultural with respect to each winter team's station culture.

Mental distress patterns somewhat consistent with the WOS were also documented at the Indian Maitri Station (Bhargava, Mukerji, & Sachdeva, 2000). Their work-life satisfaction declined gradually and was lowest in the last month of isolation, not in the mid-point of winter. This may be a cultural variation of the WOS; but Bhargava et al.'s (2000) crew spent 14 months in Antarctica, two months longer than Americans at McMurdo. This is likely to shift their lowest point of well-being to the mission mid-point which is not necessarily mid-winter. The Indians also reported their maximum sleep disturbance mid-winter, in accordance with the classic WOS. Bhatia and Pal (2012) documented that 3% of medical consultations in the Indian expedition to Maitri between 2008-2009 were psychiatric in nature. Participants complained of lethargy and loss of appetite, so they were counseled and advised to exercise regularly while maintaining a balanced schedule. Bhatia and Pal (2013) confirmed this incidence over seven different expeditions at Maitri between 1993 and 2011. Only 2.66% of medical consultations were due to psychological disturbances such as anxiety, depression and insomnia. These symptoms are congruent with the WOS but neither Bhatia and Pal (2012) nor Bhatia et al. (2013) reported on their circannual patterns.

However, Premkumar et al. (2013) documented that the team at Maitri felt more depressed, sad, fearful and hostile during the winter isolation. A possible explanation of this mood variation may be latitude (Palinkas & Houseal, 2000) but these Indian participants differ from Tanaka and Watanabe's (1994) and Ikegawa et al.'s (1998) Japanese participants, despite Maitri (70°S) and Shōwa (69°) being at a similar latitude (see Figure 1.1) with similar length of polar night (two months for Maitri, 45 days for Shōwa). According to Bhati and Pal (2012) Maitri's temperature fluctuated from 0 to -30 degrees during their study while the Japanese Meteorological Agency (2013) gives the fluctuation for Shōwa from +1.1 to -23.3 degrees. It is possible that this difference in temperature produces these inter-station differences but given that all station interiors – where subjects spend most of their time – are climate-controlled for comfort, this seems unlikely.

Cross-cultural differences in polar mood fluctuations have been documented, regardless of station latitude (Palinkas, Johnson, Boster, et al., 2004). Palinkas, Johnson, Boster et al. (2004) compared different stations and cultures to those of the Americans at Amundsen-Scott (90° S). Indian nationals at Maitri (70°S) experienced more anger, depression and vigor but less fatigue over the course of winter. This somewhat contradicts Bhatia et al.'s (2013) findings but Palinkas, Johnson, Boster et al. (2004) observed circannual psychological disturbances directly, instead of general medical consultations. It is possible that these problems existed in Bhatia et al.'s (2013) participants but were not reported to the medical consultant. Palinkas, Johnson, Boster et al. (2004) also reported on Russian (Vostok, 78°S), Polish

(Arctowski, 62° S, sub-Antarctic) and Chinese (Great Wall, 62° S, sub-Antarctic) nationals. The Russians felt more anxious but less depressed, fatigued and vigorous during winter. The Polish were more angry and less vigorous and fatigued than the Americans. The Chinese reported higher levels of depression and confusion but felt less vigorous and fatigued. Latitude-wise, the Chinese reported more confusion than the Polish, despite their stations being geographically close. Maitri (70°) did not receive latitude-based comparisons because none of the others were at a similar latitude (see Figure 1). Palinkas, Johnson, Boster et al. (2004) suggest that their different findings might be explained by how different cultures attach meaning to their experiences of polar missions and the questionnaires used, rather than how differences in their adaptation. It is also possible that crew characeristics played a role as Arctowski and South Pole were the only teams with female members, while more American and Russian team members had previous winter-over experience compared to the other teams. Chen et al. (2016) report that Chinese at Zhongshan Station (69° S) showed increased tension, anger, fatigue and confusion from mid to late winter and that their negative affect increased more than that of Chinese at the sub-Antarctic Great Wall Station (62° S). Chen et al. (2016) attributed this to Great Wall Station's improved habitability with more fresh food, telecommunication and social support, as well as lack of isolation. This suggests that while all stations and all cultures are affected, there is some cultural variation in the effects of polar winter on crews and some variation based on station environment and mission duration.

From the above, it becomes clear that psychological fluctuations over the time span of the mission are common, particularly in winter. These fluctuations relate to the individuals, the group composition, the passing of time, the length of the mission and the harshness of the environment. They affect a person's levels of anxiety, depression, tension and social functioning and consequently the group's success. While different cultures may be affected differently,all are affected to some degree: the 2% of Japanese (Otani et al., 2004) and 2.66% of Indians (Bhatia et al., 2013) who report psychiatric complications are in stark contrast to the historical 60% (Gunderson, 1968) and to approximately half of Palinkas, Johnson, Boster, et al.'s (2004) 5% among modern American personnel. Palinkas, Houseal and Rosenthal (1996) suggest that the number of individuals experiencing subclinical seasonal mood fluctuations may be as high as 20%. Khandelwal, Bhatia and Mishra (2015) even report an increase in depression, social dysfunction and subjective health complaints in an Indian summer crew at Maitri. However, there was no research featuring non-English speaking participants at Arctic stations over winter.

What Causes the WOS?

Given how prevalent the WOS has been throughout the last five decades, it is time to turn towards its possible underlying causes. Over the years, demographic characteristics, sleep characteristics, and station latitudes have been discussed as causes of or influences on Antarctic mood fluctuations. These factors have not been examined in the context of Arctic explorations.

In Palinkas, Cravalho, et al., (1995) participants previous winter-over experience, age, gender, ethnicity, education and financial income did not mediate their symptom severity or frequency. The only predictors of winter depression were marital status and summer depression: people who were married were more prone to winter depression, and people who experienced summer depression were likely to experience winter depression too. Together, these two factors accounted for 42% of the variance in winter depression. In Australian men, Law (1960) observed that those who had been married for several years fared better in Antarctic service than unmarried ones. However, men who had been married for less than a year prior to deployment fared worse than unmarried or long-married men (Law, 1960). Neither Palinkas, Cravalho, et al. (1995) nor Law (1960) comment on the exact length of the marriage or on men who are in long-term, unmarried relationships, so the question of these relationships' influence remains unanswered. The same applies to the quality of the marital relationships.

Changes in sleep patterns due to abnormal photoperiods may also mediate mood fluctuations. Palinkas, Houseal and Miller (2000) connected sleep and mood variations in their American participants: worse sleep in one month was associated with vigor and confusion the following month, independent of concurrent sleep characteristics. The less and worse participants slept, the more tense and depressed they felt. The later and worse participants slept in one month, the angrier they felt the following month. Sleep quality's influence on mood was independent of demographic characteristics such as marital status. Palinkas, Houseal, et al. (2000)also commented that sleep quality seemed to improve over the polar night. However, this is not the case as demonstrated above.

Palinkas, Gunderson, Holland, Miller and Johnson (2000)suggested that their American Navy men who spent a winter in Antarctica between 1963 and 1974 showed fewer depressive symptoms in higher latitudes with harsher physical environments. Palinkas and Houseal (2000) replicated this finding with American civilian and Navy personnel from Palmer, McMurdo and Amundsen-Scott stations: different latitudes produced different effects in same-culture crews. The Amundsen-Scott crew's tension-anxiety, depression, anger, confusion and fatigue levels declined over winter. In spring, tension-anxiety and fatigue increased while vigor declined. McMurdo participants exhibited this pattern of winter improvement followed by a decrement in spring for tension-anxiety. The sub-Antarctic Palmer Station participants reported no significant changes; their mood stayed even throughout their mission it neither improved or worsened in comparison to McMurdo and Amundsen-Scott. More recently, the personnel at Palmer was observed to have the highest number of psychological consultations of the three (Pattarini, Scarborough, Lee Sombito, & Parazynski, 2016). These findings suggest that the more extreme the environment, the less severe the symptoms of the WOS. This can be interpreted as a harsher Antarctic climate prompting a greater adaptive response (Palinkas & Houseal, 2000). Additionally, a larger crew size is associated with fewer WOS symptoms

(Palinkas, 1991b). This suggests that for Americans, small-sized Antarctic stations in milder or moderate climates such as Palmer, would be the most difficult social environments.

Wood et al. (2000) were the only researchers who asked their Australian participants at Mawson, Davis, Casey and sub-Antarctic Macquarie Island stations directly whether anything disrupted their lives over the course of the mission. Most frequently, participants reported no problems at all but the problems that were named related to work issues, antagonisms in the team, problems with the station commander, concerns about health and sexual relationships at the station. Sadness and depression came only after all of these issues, suggesting that the impact on participants' moods and emotions was primarily based on the social environment of the station.

Antarctic crews require coping and support strategies that help them not just survive but thrive on their missions. This is particularly relevant because Sandal's (2000) participants explained their negative mood with loneliness and being mocked. Three people felt especially excluded because they did not speak the same language as the majority (Norwegian). This is another complication that ICE crews have to deal with among themselves because: bullying at work cannot be prevented by their organisations in the outside world.

How do People Cope with Polar Missions?

So far, the approach to choosing the participants for general polar missions documented in the literature has been to select the most suitable applicants based on mental health and/or personality characteristics. For example, Taylor (1969) described that the New Zealand Antarctic Division selected out the "psychotic, neurotic, homosexual and eccentric" (p. 83) because of the selecting panel's subjective reactions towards them. McCormick, Taylor, Rivolier and Cazes (1985) observed that in their Australian traverse expedition, participants who repressed their worries ("repressors") reported stress more often, but at a lower level. On the other hand, participants who appraise their worries ("sensitizers") reported stress less frequently. This suggests that neither technique is preferable for Antarctic coping but McCormick et al. (1985) also observed that the highest-scoring repressor was not seen as well-adapted by the researchers and his peers because he was too risk-taking. Grant et al., (2007)found that those crewmen who were seen as poorly adapted by their commanders showed higher levels of defensive hostility and lower levels of emotion-focused coping. The well adapted crewman, on the other hand, scored higher on openness to experience and emotion-focused coping. So, psychometric testing of personality characteristics can contribute to personnel selection by predicting adaptation. This makes personality characteristics important factors to be considered at the selection stage, before deploying a mission (Grant et al., 2007). Similarly, Palinkas, Gunderson, et al. (2000) have shown that people with high levels of neuroticism are more likely to experience depression whereas those with low extraversion and low conscientiousness were considered ideal candidates by their peers. High openness to experience was also considered desirable. Rosnet et al., (2000) showed that in modern French Antarcticans at Dumont d'Urville Station, extraversion and assertiveness were the least desirable personality traits because these people were perceived as intrusive and disharmonious to the group. Steel et al. (1997) showed that in comparison to normative groups, polar expedition members were less depressed and anxious but more active, open and agreeable. They also showed that Antarctic crew members were less neurotic and more agreeable than Arctic ones but highlighted that this might be due to the majority of their Arctic participants being Canadian – it could be a cultural difference. However, there is no research suggesting that Canadians differ from other cultures in these traits. Canadians are suggested to display contempt more intensely than Americans and Japanese (Safdar et al., 2009)but it is unclear whether this would affect the personality differences.

Palinkas, Johnson and Boster (2004) investigated the coping mechanisms of American Antarctic personnel. The support from their friends and family at home remained equally available to participants across the mission but they perceived it as increasingly unsatisfactory over time. This was likely because they had no possibility for face-to-face conversations. Contact with loved ones at home may thus be a source of stress itself because polar crew members worry about their families. Unsurprisingly, fellow crew members are also a poor source of support because they undergo similar distress. While their participants sought advice less frequently over the course of winter, those who did seek advice also felt more depressed. The authors speculate that this may be because the adviceseeker hopes that their source of support has mental or emotional resources at hand that they themselves are currently lacking. In turn, seeking advice from someone who undergoes similar problems may be unsatisfactory because they cannot offer the desired support or because they refuse the desired support. This would lead to the increase in depressive mood consistent with the WOS (Palinkas, Johnson, & Boster, 2004). It also reveals a lack of available coping resources for those who need them.

Schmidt, Wood and Lugg (2005) described that social support was not related to leadership effectiveness, gender diversity, age and age variation in Australian crews. However, female leaders received substantially less social support than other crew members, providing an additional source of stress for them. This is particularly important because leadership effectiveness is highly important for the team climate (Schmidt, Wood, & Lugg, 2004). This evidence suggests that requesting social support within Antarctic settings may result in reception of unsatisfactory support or rejection altogether, especially for female leaders. This issue needs to be addressed when preparing crews.

In summary, these studies leave the following question: if the hardships of wintering over result in such lack of support, how can we improve people's coping strategies? The above evidence suggests that a suitable Antarctic winter candidate is not married or is married for a long time, did not suffer from summer depression in earlier missions, does not take too many risks, is very open to new experiences and copes with stressors by focusing on her/ his own emotions. There is empirical evidence linking (neuro-) psychological fluctuations and psychoneuroendocrine changes (Palinkas et al., 2001) and the treatments of these can address the symptoms of the WOS.

So, having explored the WOS, its causes and possible coping strategies, the PT3 will be discussed.

The Polar T3 Syndrome (PT3)

In a euthyroid population, the PT3 presents itself similar to sub-clinical hypothyroidism. When missions begin during the austral summer, exposure to cold precipitates a shunting of T3 hormones into skeletal muscle, which reduces the availability of T3 and T4 hormones in the brain. This is followed by a further decline in T3 and T4, similar to the sub-clinical hypothyroidism. Consequently, the hypothalamic-pituitary-thyroid axis (HPA) stimulates the increased secretion of these two hormones and the increased levels of free T3 and T4 (Palinkas et al., 2001). These psychoneuroendocrine changes are associated with psychological fluctuations in Antarctic crews (Palinkas et al., 2001). The reduced T3 and T4 in the brain leads to an increase in tension-anxiety and confusion, which in turn lead to a further decline in T3 and T4. Afterwards, the HPA stimulates the increased availability of these two hormones contributing to a decline in negative mood (Palinkas et al., 2001). This study reports on Americans but the PT3 has been observed cross-culturally, just like the WOS (Xu et al., 2003).

The Chinese displayed a similar increase in thyroid-stimulating hormones (Xu et al., 2003). However, they did not display the same decline of T3 and T4 hormones, or a doubling in T3 distribution rates, appearance rates and clearance rates as the Americans. Still, the psychological effects were similar: lower levels of T3 and T4, as well as higher thyroid-stimulating hormones were associated with increased tension-anxiety, depression, anger, confusion and total mood disturbance. It must be noted, nevertheless, that the hormonal data collection took place in Beijing before and after the mission (December 1999 and 2000), while the mood measurements were collected at the station itself (April to October 2000). More concurrent measurements would offer further insight.

Reed et al. (2001) reported on two treatment groups: a placebo group and a thyroxine supplementation group. For the first four months of their stay, both groups consumed placebos; but for the final four months, the experimental group consumed 0.05mg thyroxine daily. In both groups, a higher level of thyroid-stimulating hormones preceded higher depression, tension-anxiety, anger-hostility and total mood disturbance, along with lower vigor. Similarly, increased free T3 preceded higher fatigue and confusion in both groups. While visual memory improved with supplementation, mood did not. This is contrary to Palinkas et al.'s (2001) observations where increased T3 contributed to a mood improvement. Both studies used euthyroid American participants at McMurdo in successive years, suggesting that there may be other, unmeasured hormonal factors contributing to the different results of the studies. These could be due to individual differences between the participants and different occurrences in everyday station life that affect emotional well-being.

Palinkas, Reedy, Shepanek, et al. (2007) compared participants at McMurdo and Amundsen-Scott stations. The Amundsen-Scott participants exhibited greater accuracy and efficiency at complex tasks, while having higher levels of free T3 and T4. The higher their free T4 levels, the lower their fatigue and depression. This is in accordance with Palinkas et al., (2001). Palinkas, Reedy, Shepanek, et al. (2007) conclude that HPA functioning is more strongly affected by Amundsen-Scott's more extreme environment, compared to McMurdo. This seems to suggest that residence at Amundsen-Scott facilitates greater cognitive and HPA functioning than residence at McMurdo. It also suggests that austral summer has a positive effect on HPA and cognitive functioning at Amundsen-Scott

Palinkas, Reedy, Smith, et al. (2007) used a placebo group; a group which received thyroxine and triiodothyronine supplements; and a group which received tyrosine supplements. Overall, they found no cognitive decline but the mood patterns of all groups resembled the WOS. Palinkas, Reedy, Smith et al. (2007) found that thyroxine and triiodothyronine supplementation showed no benefits for cognition or mood. Tyrosine supplementation appeared to improve cognitive performance and mood compared to thyroxine and triiodothyronine, but not in comparison to placebos. This absence of cognitive benefits under higher thyroid hormone levels is contrary to Palinkas, Reedy, Smith et al. (2007) whose participants at Amundsen-Scott with higher natural thyroid hormone levels showed better cognitive functioning. This could be because Palinkas, Reedy, Smith et al. (2007) did not analyse their data separated by station. The differences in light exposure or temperature at different latitudes may have affected thyroid functioning. Given these mixed results of hormonal therapy, Palinkas et al. (2010)looked into light therapy. Participants received light treatment even in the summer months to see if there was an effect of the cold and light on thyroid function. Depressive mood increased less in the white light treatment groups than in the dim light treatment groups. In winter, light treatment prevented mood decrements. In the summer, bright light therapy was associated with a faster reaction speed and a worse accuracy in more complex tasks, compared to dim light. Palinkas et al. (2010) concluded from this that euthyroid subjects' thyroid function can be improved by using light therapy during the winter months. They suggest that in winter, light therapy is equally effective compared to thyroid supplementation. However, considering that the hormonal supplementation appeared more effective for cognitive decline while the light therapy appeared more effective for mood declines, a combined approach may be most appropriate.

To date, we can see that both hormonal and light therapy can alleviate the symptoms of the PT3 and the WOS, offering a comprehensive prophylactic, in situ treatment of both. However, the WOS and the PT3 constitute only short-term effects of Antarctic residence and they have not been investigated at all in the Arctic. Our next section focuses on the long-term effects of polar residence on human health.

Long Term Effects of Polar Residence

Palinkas (1987) followed up on the first hospitalization rates of 327 U.S. Navy personnel who had over-wintered in Antarctica between 1965 and 1979 and those personnel stationed elsewhere. Antarctic personnel showed a smaller disease incidence in the six months prior to deployment and the first six months in Antarctica. These persons also had a lower rate of first hospitalizations in the nine months following their return home. Palinkas (1987) explained these findings with a psychosocial adaptation process that was facilitated by the importance Antarctic teams attach to psychologically and physically healthy behaviours.

This shows that Antarctic winter-over duty is likely to have beneficial effects on long-term health and well-being, compared to the short-term adverse effects described above. In regard to the better health prior to deployment, Palinkas (1987) does not indicate whether his participants knew that they had already been selected when they reported fewer disease incidents. If they knew, the lower disease incidence may have been due to an anticipation effect: if they did not, it could be participants did not wish to be excluded based on illness, and thus did not report their illnesses; or perhaps they were so keen to go to Antarctica that they took extra care not to contract any illnesses or injuries prior to deployment. Our literature search produced no evidence in relation to any of these questions. We could not find long-term follow-ups on HPA functioning either, nor on Arctic crews, making these worthwhile topics for further research.

The remaining topics to be addressed are traversing teams and camps. Our readers will have noticed above that since the study of Cochrane and Freeman (1989), we have not reported Arctic evidence. That is because none of the remaining Arctic studies apply to the phenomena described above: they focus on camps and traverses instead.

Traverses and Camp Expeditions

McCormick et al. (1985) reported on eleven Australians who were traversing the Antarctic Plateau which is an icy desert with constant blizzards. The main stressors were social isolation and unchosen colleagues, augmented by additional stressors of small and cramped tents for housing, no access to water closets, exposure to the harsh climate; no opportunity for rest or leisure and monotonous, difficult to prepare food. McCormick et al. (1985) had exposed six out of their eleven expedition members to artificial acclimatization for ten days before their departure to Antarctica. This involved sitting in a 15° Celsius bath for an hour a day; but this artificial acclimatization did not produce any psychological effect. This suggests that preparing for the Antarctic hardships is not possible by pre-deployment acclimatisation. Similarly, Ursin et al. (1991) report on a group of men from France, the UK, the US, the Soviet Union, China and Japan that spent a summer in Antarctica. Meticulous planning relieved some of their stressors such as the unexpectedly bad weather but their emotional needs were met by forming close relationships with the team's dogs. This is no longer possible for contemporary teams because non-native species have been banned from Antarctica as of 1994.

Wood et al. (2000) studied six men who travelled from Mawson to Davis Station (2250km) and back. For the group, tensions increased linearly over time. But on an individual level it became clear that perception and coping strategies varied greatly between and within participants. Arctic traverses have reported different psychological complications as shown by Pope and Rogers (1968). Their account of a 200km march across Alaska completed by thirteen men recorded the group's biggest worries: the extreme cold and sleeping outside, the danger of falling through ice into a river and single file marching which prevented conversations. The greatest frustration arose from the bulkiness of their equipment, the difficulty of falling asleep due to elemental exposure and the risk of falling over in the snow and being unable to get up alone. One member experienced a short psychotic episode where he became very suspicious of the others but otherwise, no psychological complications arose. A psychiatrist was available and supported the participants's emotional coping through conversations, which might be the reason for such few psychological disturbances. Similarly, Bishop, Grobler, & Schjoll's (2001) two-headed Greenland traverse in boreal summer showed that participants complained about the logistics and weather but reported lower subjective stress than their cortisol levels suggested. Leon and Scheib (2007) also reported on a two-headed Arctic traverse team and their wives at home. This team had to be evacuated due to adverse weather conditions. After the leader decided on this evacuation, the partner refused to speak with the leader for the entire week while waiting for the rescue helicopter. He was extremely disappointed, angry and worried about his reputation at home but the leader maintained that his decision was correct. The two men overcame their difficulties within four months of their return. At home, both of them noticed that their spousal relationships needed more work: the leader's wife, who had prior experience of her husband departing on such missions wondered if she could really withstand this stress again. Her husband's expedition's bad progress was discouraging her; and she felt that people in her social environment showed more interest in her husband than in her. Both wives took this time to develop some independence from their husbands; reaching to the point where the partner's wife bought a house on her own. Leon and Scheib (2007) conclude that extremely achievement-oriented individuals such as the expedition partner may jeopardize the expedition's safety for personal goals and should therefore be selected out. They also noted that the expedition members returned to a changed family life and that they could benefit from a better support network for the re-integration of these families. It remains to be determined what sort of support families would wish for, if male and female spouses differ in needs while their wives and husbands are exploring polar regions, how children are affected and if there is an ideal polar exploration spouse, as well as an ideal polar team member.

Palinkas, Suedfeld, and Steel (1995) reported on seven members of a three-week expedition to a decommissioned Canadian weather station on Ellef Ringnes Island during boreal summer. The decommissioned station's un-heated buildings had inside temperatures from +4 to -10 degrees Celsius. They found that participants' depression, tension-anxiety, fatigue and confusion declined during the course of the expedition. Participants' mood was worst immediately before departure and in their first week at the station. Palinkas, Suedfeld, et al. (1995) speculate that the polar environment may have provided a respite from stressful, urban life; or the participants were unusually low in neuroticism and thus well-suited for their mission; or mission anticipation may have caused unusually high scores prior to departure while the lower scores at the station reflect the normal scores of these people. This suggests that short Arctic missions can be psychologically beneficial and enjoyable despite physical hardship.

For Steine, Steine, Sandbaek, and Roseth (2003), only an abstract was available. It indicated that five men who skied for five weeks in Northern Canada reported less stress after the mission than before. They struggled with the perceived expectations placed on them and strived for group consensus. Positive mission characteristics were a strong group identity and friendship, supporting the notion that Arctic missions can be enjoyable.

These studies suggest that the inherently smaller polar traverse teams may experience more amplified group tensions than station teams. However, the great hardships of polar traverses mean that people focus on physical problems more than on social ones. The greater exposure to the elements can also have a greater effect on the mission such as its termination altogether in Leon and Scheib (2007) or it can become the main stressor, as reported by Pope and Rogers (1967).

1.4.3 Conclusions from Six Decades of Polar Psychology

There is a substantial difference between the number of studies examining psychological aspects of Arctic and Antarctic sojourners: only 10.91% of the relevant publications were focused on Arctic teams. Moreover, Arctic studies tend to focus more on traverse expeditions, while Antarctic ones focus on stations.

The evidence presented above suggests that polar wintering is inherently stressful. Crews need to adjust to the isolation, the prolonged darkness and the confinement with their colleagues. This affects the mood in all polar expeditions to varying degrees. These variations can be based on the station's latitude, on differences in microcultures between different expeditions at the same station or they can be based on different national cultures. These variations concern when in the mission which type of mood is affected, not whether there is an effect altogether. For example, American, Australian and British participants have reported increased irritability, anxiety and depression over polar night. Chinese participants have demonstrated a decline in vigor rather than an increase in negative moods while Japanese participants report a low in morale at mid-winter. Russians felt more anxious but less vigorous and less depressed than Americans; Polish reported more anger and less vigor than Americans in the Antarctic. Our Arctic studies reported on Canadians, British, Norwegians, Australians and Americans. Here, the variation seemed to be more dependent on whether the team was at a station or on a traverse. Traverse expeditions were perceived as more physically stressful than station expeditions and in some cases as more socially stressful because they featured smaller teams with more possibility for conflict. This is true for our Antarctic traverse studies, too. We conclude that with some variation, all crews are psychologically affected by polar expeditions and the effect of these expeditions is mediated by the expedition's duration, location and team members. Positive aspects of polar missions were only explored in one study (Wood et al., 2000) and implied that field trips and work gave participants joy most frequently.

Limitations of the Literature Review

Only nine out of our 32 original research articles focused on non-English speaking participants (Bhargava et al., 2000; Bhatia, Malhotra, & Agarwal, 2013; Ikegawa et al., 1998; Otani et al., 2004; Palinkas, Johnson, Boster, et al., 2004; Pope & Rogers, 1968; Tanaka & Watanabe, 1994; Xu et al., 2003). Ten of the 19 papers that were not found by the search engine were cross-cultural (Bhatia & Pal, 2012; Chen et al., 2016; Décamps & Rosnet, 2005; Khandelwal et al., 2015; Otani et al., 2004; Peri et al., 2000; Premkumar et al., 2013; Rosnet et al., 2000; Steel et al., 1997; Weiss et al., 2000) which suggests that cross-cultural research was at a disadvantage through the search engine, even when it was published in English.

Arctic literature was also at a disadvantage but not due to methodological problems: no additional papers turned up when searching for them without stratification. This suggests that the six papers we reviewed here (Bishop et al., 2001; Cochrane & Freeman, 1989; Leon & Scheib, 2007; Palinkas, Suedfeld, et al., 1995; Pope & Rogers, 1968; Steine et al., 2003) were not just the most suitable papers – they were also the only papers focusing on Arctic teams under conditions of ICE to be found. This implies a vast gap for future researchers to address.

This discrepancy may be explained by the fact that the Antarctic continent is an excellent space analogue for mission training: space teams preparing themselves in the Antarctic Dry Valleys will come as close to experiencing the Martian planetary surface as possible (Suedfeld & Weiss, 2000). However, Greenland is also similar to Mars in terms of temperature flux so both polar regions offer singularly sterile, hostile terrains to train space crews (Bishop et al., 2001). And from the psychological, behavioural and cognitive perspectives, Arctic teams may provide equally valid insights. Suedfeld (1991b) points out that Arctic teams are more accessible, implying that because they are easier to evacuate, and thus have received less attention. Nevertheless, Arctic evacuation can still be very dangerous, complicated and expensive. Additionally, the claim that Antarctic winters are more psychologically challenging due to the continent's harsher climate has never been empirically verified. High-quality selection techniques and crew preparations would be suitable approaches in Arctic psychology, too, especially when considering polar bears and fire arms as additional threats.

Future Directions for Polar Psychology

Many questions remain unanswered in polar psychology. We need to know whether Arctic crews differ from Antarctic ones, and if they do, in what way and why. What stressors are unique to the Arctic crews and which ones are shared with Antarctic colleagues? Additionally, most of the literature yielded by our systematic search has focused on the negative effects of polar missions. But Wood et al. (2000) point out that 25% of Australians volunteer repeatedly for future missions after completing their first one, so there must be a positive incentive to return which has not been extensively studied. If we knew more about positive effects of polar residence, we could deliberately increase them to help the expedition members cope. Such an approach, giving more prominence to positive aspects of the experience and in particular to the development of coping mechanisms to deal with physically and psychologically challenging environment would be also in line with the growing emphasis of resilience as a crucial factor of mental health (Davydof, Stewart, Ritchie, & Chaudieu, 2010).

In terms of methodology, Wood et al. (2000) are the only researchers using qualitative methods, which means detailed insight into station life events is lacking. In addition, very few studies employed control groups to account for normal mood fluctuations throughout the calendar year. So it is unknown how polar teams fare in comparison to people at home. Finally, for the last 50 years the approach has been to select out the unsuitable candidates, but even the suitable candidates experience psychological distress during their missions. It is, therefore, important to research in situ coping strategies rather than waiting for time to pass and complications to fade. Some successful approaches have involved thyroid supplements and light therapy. But it may be beneficial to develop a coping strategy that the individual expedition member can apply to any personal psychological issue they may encounter, including interpersonal tensions. Such a strategy must allow self-sufficiency without the help of a psychologist, psychiatrist or medical doctor. In-depth knowledge about as many ICE as possible will help mankind prepare for our biggest ICE challenge yet: long-term manned space flight.

1.5 Methodology in Modern Polar Psychology

1.5.1 Polar-Specific Issues

The descriptions of the physical environments can be found in Sections 1.2 and 1.3, so here, their consequences on research procedures will be described. Lugg (1991, p. 38) outlined several constraints to Antarctic human research, and called them the “A”-Factor. Firstly, he listed participant-related problems, some of which can be encountered in any psychology study, such as attitude and compliance problems, or participants falling ill. Nevertheless, polar psychology features much smaller numbers of participants which complicates statistical analyses, and because of their heavy occupational duties, Antarctic sojourners may be less available than participants in non-ICE. An example of such a duty would be collecting snow to turn into water for showers. Secondly, the geographical remoteness of the stations means that it is impossible for participants to come into psychological laboratories for the measures to be taken. All measures have to be taken in situ, which makes data collection very complicated because one does not have unlimited access to participants, or unlimited choices of instruments to employ. The necessity for direct testing (and the associated substantial costs and logistic challenges) in the ICE could be circumvented in two ways: all neuropsychological tests and questionnaire data can be computerised (see Palinkas, Reedy, Shepanek, et al., (2007); Palinkas, Reedy, Smith, et al., (2007) for such an application) or, if conducting clinical interviews, the data can be collected before and after, but not during Antarctic residence (see Palinkas, Glogower, et al. (2004)). Both approaches have advantages and disadvantages.

The main advantage of computerised, remotely-administered testing is that it is cheap, compared to the expenses of sending a psychologist to a station. If an institution were to send a researcher in person, they would need to finance this person's board for a year, in addition to their salary. Furthermore, the institution would lose one of the valuable, limited expedition places which might otherwise go to a researcher whose background is closer to the overall mission's goal. Administering computerised tests and questionnaires also has the great advantage that the data can be collected in situ, so during polar night, and not just before and after. Transporting a researcher to and from a station in mid-winter is out of the question, since evacuation of those in need is nearly impossible (I. C. Grant, 2004), see Kumar and Duong (2012) for a review on those who had to cope with life-threatening medical emergencies as a result of this. Data collection purposes would not warrant the danger that such an operation would pose to the researcher, the pilots and the equipment.

There are, however, several disadvantages of administering computerised neuropsychological assessments. They lack behavioural participant observation; because this requires a human researcher. Behavioural observation can lead to valuable insights. Furthermore, none of the studies outlined in below report anamnesis of self-observed cognitive changes. This suggests that it was not done, due to the researchers not being present at the station. While anamnesis could be administered as a digital questionnaire, or done with Skype interviews, online administration can also run into complications, depending on the station's internet access and weather conditions. Many stations use satellite connections, which can be disturbed in blizzards. The extreme weather conditions may cause malfunctioning of technological instruments (Lugg, 1991, p. 38), making pen-and-paper assessments a more attractive option.

Testing only before and after, but not during polar night significantly reduces the costs of the study but also reduces the amount of data one can collect. Several months' worth of questionnaires or cognitive assessments would be missing in such studies so the applicability depends very much on the research question asked. If a study were to focus on the prolonged effects of the polar mission (Palinkas, 1987) or on how people feel after the polar night (Palinkas, Glogower, et al., 2004), this would not necessitate researcher-participant interaction during the polar night. However, if the goal is to observe a team throughout their mission or to ask them about their experiences during the polar night, this approach is unsuitable because it lacks data.

A rare, third possibility would be recruiting one of the expedition members as the researcher's "in situ data collector". On occasion, researchers were their own participants (e.g. Palinkas, Suedfeld, et al., 1995) or the expedition doctor collected the necessary data (Bhatia & Pal, 2012); but common expedition members whose duty does not consist of other people's well-being lack the time and motivation to collect data for a far-away researcher.

Thus, when evaluating the methodology below, one needs to keep in mind the limited options available to these researchers, which explain the repeated use of a small variety of measures across the literature. Now, the cognitive, questionnaire, and interview methodology used in previous studies will be critically discussed to show the options and justify the domains chosen for this dissertation. Details about the exact choices of instruments are presented in Section 2.5.

1.5.2 Cognitive Methodologies

Here, the results from laboratory and polar conditions are summarised. Laboratory, under these circumstances, means participants who may or may not reside in the Arctic circle, but are not confined to a polar research station. These participants are usually exposed to controlled conditions of cold and darkness in laboratories, but not to the confinement and isolation of polar research stations. Table A2 in Appendix A gives an overview of the relevant studies. The most commonly used computerised measures of cognition are the *Automated Neuropsychological Assessment Metrics for Isolated and Confined Environments (ANAM-ICE)* and the *Naval Medical Research Institute Performance Assessment Battery* (NMRI-PAB, see Table 1.3 for details on each battery). These batteries often do not only calculate the speed and accuracy with which the tasks are performed but they include efficiency as a measure of the two.

Table 1.3

The Tests and Domains assessed by ANAM-ICE and NMRI-PAB.

Battery	Test Name	Cognitive Domain(s)
ANAM-ICE (adapted from Rice et al., 2011)	Code Substitution (Code Substitution–Delayed)	Associative learning (speed/ efficiency) Memory (delayed)
	Continuous Performance	Working memory
	Logical Reasoning	Reasoning
	Matching-to-Sample	Visuo-spatial memory
	Simple Reaction Time	Basic neural processing (speed/efficiency)
	Sternberg Memory Search	Memory
NMRI-PAB	Matching-to-Sample	Short-term spatial memory
(adapted from Palinkas et al., 2005)	Simple Reaction Time	Basic neural processing (speed/efficiency)
	Serial Addition/Subtraction	Sustained attention
	Grammatical Reasoning	Reasoning
	Repeated Acquisition of Response Sequences	Learning capability and short-term memory

Neither of these instruments has a parallel version, making repeated assessments with these batteries prone to improvement due to practice effects. According to the website of ANAM developer VistaLifeSciences (2015), this software "…provides randomized stimuli across tests sessions, creating an almost limitless number of alternative forms and combinations to facilitate repeated-measures testing." Nevertheless, practice effects have been documented in the ANAM-ICE under laboratory conditions, especially for the Continuous Performance Task, on which participant performance increased with every single administration (Mäkinen et al., 2006). This suggests that while these two batteries certainly have the necessary advantages of remote, computerised neuropsychological assessment outlined in 1.5.1, they also have the major drawback of potentially finding cognitive improvements due to practice effects. Subsequently, the evidence supplied by them will be discussed below and employed exclusively to justify the choice of the cognitive domains to be assessed in the course of the present study. Details on each study's methodology can be found in Appendix A, Table A2.

Executive Functions

Sustained Attention. When using the Serial Addition/Subtraction Task of the NMRI-PAB under laboratory conditions, an artificially-induced, 24-hour cooling period yielded a faster RT but a declined accuracy (Palinkas et al., 2005). Additionally, when comparing post-cooling performance in the summer and winter, the RT and accuracy were better in summer (Palinkas et al., 2005). This suggests a detrimental effect of cold and darkness on attention. In Antarctic stations, Code Substitution of the ANAM-ICE has been used and it was found that participants at South Pole Station performed more slowly than those at McMurdo Station (Pääkkönen, 2010). Overall, a longer Antarctic residence appeared to coincide with better accuracy and improved efficiency, suggesting beneficial effects of the cold, darkness and isolation. Palinkas, Reedy, Smith, et al., (2007) report similar findings: South Pole

Station participants were more accurate and efficient at all complex cognitive tasks of the ANAM-ICE. Under laboratory conditions, however, performance on Code Substitution worsened: participants' RT slowed down, and efficiency decreased, supporting a detrimental effect on sustained attention (Mäkinen et al., 2006). This suggests that while Antarctic residence can lead to adaptation, and subsequently improved sustained attention, short-term laboratory exposure is more detrimental. Given the lack of Arctic evidence on sustained attention in research station personnel and the mixed results of previous studies, it will be worthwhile to include a measure of sustained attention.

Reasoning Skills. Logical and Grammatical Reasoning Tasks have yielded very different results in the literature. Grammatical Reasoning from the NMIR-PAB has, under laboratory darkness conditions, and under combined cold and darkness conditions, RT was faster and accuracy was higher (Pääkkönen, 2010). When comparing summer and winter results, RT were faster in the summer in one study (Pääkkönen, 2010) but unaffected in another (Palinkas et al., 2005). Logical Reasoning from ANAM-ICE at Antarctic stations has produced slower RT at South Pole Station than at McMurdo Station, and it has been found to be slower in summer than in winter (Pääkkönen, 2010). On the other hand, Palinkas, Reedy, Smith, et al. (2007) show an overall higher accuracy and efficiency for personnel wintering at South Pole Station compared to McMurdo Station for this task. Under laboratory conditions, Logical Reasoning has produced slower RT following cold exposure over the span of ten days. Overall, these results suggest that reasoning, as an executive skill is affected by exposure to cold and/or darkness. In laboratory conditions, these results are very mixed but under Antarctic conditions, winter seems to produce favourable effects on reasoning. This conclusion can be drawn from the above by considering that Logical Reasoning was performed more slowly in summer, and more accurately and efficiently by the personnel wintering on the geographic South Pole. It is interesting, that no matrix reasoning or other visually-based reasoning tasks have been used so far. In any case, the evidence suggests an effect of cold and darkness on reasoning skills and they should be included in the present study.

Processing Speed. Most studies included a Simple Reaction Time Task. Under laboratory cold conditions, more mistakes were made on this part of NMRI-PAB; and under cold and darkness conditions, more mistakes were made with a faster response time (Pääkkönen, 2010). But in summer, RT were faster than in winter (Pääkkönen, 2010). This finding of declined accuracy after 24-hour non-hypothermic cold exposure was confirmed by Palinkas et al. (2005), but reversed under Antarctic conditions, RT here were slower in summer (Pääkkönen, 2010). Simple Reaction Time Tasks also produced no differences between South Pole and McMurdo Stations. The Norwegian military garrison group decreased in accuracy but increased in their completion of a four-choice reaction time task after a nine-day field training (Hodgdon, Hesslink, Vickers, & Hilbert, 1991). These findings suggest that Simple Reaction Time Tasks, from NMRI-PAB and ANAM-ICE are highly susceptible to a speed-accuracy trade-off in cold and dark conditions, but not in Antarctic conditions. Mäkinen et al. (2006) have reported accuracy performances between 93.5% and 98.8%, for conditions of bright light and warm temperatures as well as dim light and cold temperatures. This suggests a ceiling effect in the Simple Reaction Time paradigm. For the present study, when considering the domain of processing speed, a more complex paradigm than simple reaction time should be chosen to avoid ceiling effects.

Memory

Learning. Accuracy of the NMRI-PAB Repeated Acquisition improved post-cold exposure, and after cold and darkness exposure, accuracy and RT improved (Pääkkönen, 2010). These findings were replicated by Palinkas et al. (2005), and supplied by the finding that accuracy on this task was lower in summer than in winter. In the only Antarctic study accuracy on an Acquisition Task increased from Month 2 to Month 12 of Antarctic residence, but RT was not measured (Paul, Mandal, Ramachandran, & Panwar, 2010). This suggests that learning is disrupted by short-term exposure to cold, and cold and darkness, but that it is facilitated by Antarctic residence. Again, the absence of Arctic evidence in this area indicates a gap in research which this study aims to close.

Recognition. Using Matching-to-Sample paradigms, it was found that RT decrease with darkness exposure, while cold and darkness exposure led to a decrease in RT and an increase in accuracy, i.e. an improvement in overall recognition performance (Pääkkönen, 2010). These laboratory findings were confirmed by Palinkas et al. (2005). The ANAM-ICE version of this paradigm produced slower RT at South Pole Station compared to McMurdo Station, but improved accuracy and efficiency over the course of Antarctic residency (Pääkkönen, 2010). Additionally, Delayed Recognition improved in accuracy over the course of the Antarctic residency of Paul et al.'s (2010) Indian participants. Overall, cold and darkness, as well as isolation seem to have a beneficial, rather than a detrimental effect on recognition performance. This is especially interesting when combining the results outlined in the previous paragraph with the current ones: Learning seems to be disrupted by cold, and cold and darkness exposure, but recognition performance becomes faster and more accurate. Similarly, under Antarctic conditions, learning increases in accuracy over time, and recognition improves. To connect these two findings completely it may be beneficial to employ a single paradigm that assesses learning, and subsequently recognition performance, instead of several ones. All the results presented above were based on studies conducted in Antarctica or in cold laboratories; no Arctic data collection has taken place in this domain.

Working Memory/Short-Term Memory. The Continuous Performance Task of ANAM-ICE was used in Antarctica with the result that participants took longer, but were more accurate at the South Pole Station than McMurdo Station (Pääkkönen, 2010). In a laboratory setting, cold exposure also diminished accuracy on this task, but when testing repeatedly over a ten-day study, participants improved with each assessment, making it unsuitable for longitudinal studies (Mäkinen et al., 2006). Hodgdon et al.

(1991) discovered that in their Norwegian military participants, short-term memory remained unaffected by exposure to cold and darkness. The conclusions from this are that working memory, but not short-term memory is detrimentally affected by cold and darkness, or Antarctic residence. Nevertheless, with such clear practice effects apparent on the Continuous Performance task, this particular paradigm should be excluded from the present study.

The conclusion from the above is that the domains particularly prone to change under conditions of prolonged Arctic residence are sustained attention, reasoning skills, processing speed, learning, and recognition. These are the domains chosen for this study and the neuropsychological tests selected for their assessment can be found in Section 2.5.1.

1.5.3 Mental Health Methodologies

Mental health has usually been inferred from a variety of sources, so these will be briefly discussed. The evidence yielded by the respective studies has been critically evaluated in Section 1.4, so the emphasis here is on scrutinising the data collection methods.

In two publications, mental health was deduced from subjective health complaints to the station doctor, or scales which were constructed by the researchers specifically for this purpose (Bhargava et al., 2000; Bhatia & Pal, 2012). These instruments, however, were not made available with publication. One study employed the structured interview guide from the

DSM-IV (American Psychiatric Association, 2000) to diagnose mental health changes before and after, but not during polar winter (Palinkas, Glogower, et al., 2004). This yielded varying diagnoses (refer to Section 4.1) but this extensive interview (30-60 minutes) may be too long for repeated in situ application.

Five publications employed the *Profile of Mood States (POMS)* to infer changes in mood, and draw conclusions about mental health (Palinkas & Houseal, 2000; Palinkas, Houseal, et al., 2000; Palinkas, Johnson, Boster, et al., 2004; Peri et al., 2000; Reed et al., 2001; Xu et al., 2003). These have shown a significant decline in vigor (Xu et al., 2003). These mood changes become apparent after two to five months: fatigue and confusion increase, while vigor trends towards decrease (Peri et al., 2000). They relate to sleep onset as well as sleep duration and quality (Palinkas Houseal, et al., 2000) and are sensitive to the severity of the physical environment and T4 supplementation, which improves fatigue and confusion (Palinkas & Houseal, 2000; Reed et al., 2001). This suggests that for mood, the POMS is highly sensitive to Antarctic influences.

Rivolier, Bachelard, and Cazes (1991) recommended the *Spielberger State-Trait Anxiety Inventory* for crew selection purposes (p. 293), but this instrument has never been used in Antarctica. Four studies which focused on anxiety employed the *Anxiety Sensitivity Index* (Grant et al., 2007; Ikegawa et al., 1998; Tanaka & Watanabe, 1994; Weiss et al., 2000). While the ASI appears sensitive to age differences in Antarctic winterers (Ikegawa et al., 1998), it has produced inconsistent results regarding winter-over effects. ASI has shown increased anxiety symptomatology in one Japanese over-winter expedition, with the following year's expedition experiencing a decrease in symptoms and a third expedition showing no changes in anxiety levels over winter (Weiss et al., 2000). Perhaps this is why the *British Antarctic Survey (BAS)* recommends personality, coping and subjective health complaints assessments instead (Grant et al., 2007). These mixed results suggest that a different anxiety instrument should be drawn on in the future. Two Japanese studies used the *Environmental Stress Scale* (Ikegawa et al., 1998; Tanaka & Watanabe, 1994). This yielded fewer stress symptoms in Japanese summer camps (Tanaka & Watanabe, 1994) but generally, Japanese sojourners seem to suffer from less stress than American ones, maybe because their coping strategies differ, and because culturally, they are used to crowded living situations (Ikegawa et al., 1998).

Considering that the POMS is the most frequently used instrument, it may be worthwhile to draw on it for mood assessment in the Arctic; this would facilitate comparability to Antarctic results. When looking at the evidence from Section 1.4 and at the assessment methods outlined above, it is clear that anxiety and other aspects of mental health are also relevant to Antarctic residence. Rather than inferring mental health purely from the POMS, or relying on a single anxiety measure, it may be fruitful to employ a comprehensive questionnaire. This questionnaire should include depression, as well as anxiety and other mental health facets. The benefits of using such a questionnaire would be that participants can fill it out in their own time, removing the time constraint factor of clinical interviews, and that it could also readily be applied in situ. For this study, the POMS (Brief Version) was chosen to investigate moods, and the Symptom Checklist-90-Revised (SCL-90-R) was chosen to examine mental health; details on them are presented in Sections 2.5.1 and 2.5.2.

1.5.4 Qualitative Methodologies

All of the above questionnaire assessments focus heavily on negative symptomatology but there are some qualitative studies illuminating more positive experiences alongside the more pathogenic studies. Clinical interviews with Antarctic station personnel were conducted to investigate American Antarctic station personnel's mental health and diagnose possible disorders (Palinkas, Johnson, Boster et al., 2004); while Grant et al. (2007) used a structured, open-ended questionnaire to explore their British Antarctic personnel's negative experiences. This questionnaire was highly suggestive of inherently unpleasant experiences: "The questions ask to what degree the respondents missed their family/partners and friends at home, appreciated the team spirit at the station, experienced social support from other crew members, felt included by other crew members, and whether or not they experienced any conflicts at the station. There are also questions about physical and psychological well-being during the winter; e.g., whether they felt fit, had any sleeping problems, experienced feelings of fear or anxiety or other mood alterations." (Grant et al., 2007, p. 796). This questionnaire automatically implies that the participants do miss their families and friends at home, that they do appreciate the team spirit and that they experience anxiety or fear. According to Grant et al.'s (2007) description, no positive moods such as happiness or joy are included. This leaves insufficient room for participants to recall pleasant experiences. Stuster, Bachelard and Suedfeld (2000) analysed diaries of French Antarctic team members and found that the topic most commented on were other group members and the interactions with them: people found confinement with their colleagues distressing. Similarly, the other aspects recorded in the diaries focused on the heavy workload, the distance from home and other aspects of the TQP, which Stuster et al. (2000) deduced from this data.

The only qualitative research which allowed participants to reflect on positive and negative experiences (Wood et al., 2000) is tellingly named "Is it really so bad? A comparison of positive and negative experiences at Antarctic winter stations". This research used open-ended questionnaires where the participants wrote about their positive and negative experiences. This yielded a total of 450 responses in the negative domain, 400 of which indicated that there were no problems and 90 indicated that these individuals experienced work problems. Further frequent negative responses centred around antagonisms, the station leader and health concerns. The 300 responses in the positive domain yielded "nothing special" most frequently (more than 250 times) followed by field trips (approx. 190 times) and work. Altogether, participants reported more positive experiences than negative. Steel (2000) asked his participants to tell him about this place, and what their reasons for coming here were. This was an interview-based study but the qualitative data were reduced to quantitative ratings for publication. The study showed that these participants felt positively and passionately about the Arctic and their work in the Arctic, but it does not illuminate their experiences in detail.

This focus on unpleasant experiences in all quantitative and most qualitative approaches is inadequate because there is evidence that participants enjoy their polar expeditions (Crocq, Rivolier, & Cazes, 1973, p. 362; Oliver, 1991, p. 223; Taylor, 1973, p. 227; Wood et al., 2000). A more interactive qualitative technique than written, open-ended questionnaires would be a good approach if it can simultaneously give room to positive experiences. I chose *Interpretative Phenomenological Analysis (IPA)* for this purpose. Methodological details on how my IPA interviews were conducted can be found in Section 2.5.3.

1.6 Rationale

The conclusion of this chapter is that evidence from one ICE, like Antarctica, can be applied to other ICE where it can inform us about adaptation and coping strategies. ICE which have been missing from the literature are the research stations in the High Arctic, such as the Polish Polar Station, Hornsund. With regard to isolation, the wintering crew at the Polish Polar Station, Hornsund, faces the same challenges as Antarctic stations. The nearest settlement, Longyearbyen, is 136km away, while their friends and family remain at home in continental Europe and are not allowed to visit the station. Over polar night, the station remains inaccessible except for a short ceremonial visit by a Catholic priest around Christmas time. There is little published research on the mental health and cognition of Polish polar

Explorers and of Arctic Explorers, generally. These conditions make the Polish Polar Station, Hornsund, the ideal setting to conduct research into Arctic ICE.

The literature suggests that the WOS is the most common symptom cluster to occur over Antarctic missions. The WOS includes an increase in negative mood over winter, with an improvement towards the end of the mission. Many attempts have been made at determining predictors of the WOS, and it seems that more neurotic personalities struggle with the adjustment to new environments, while more extroverted personalities struggle with coping under ICE conditions. This is thought to be because they rely on others' support for coping, which is difficult to attain in ICE (Rosnet, Le Scanff & Sagal, 2000). Further suggested symptom clusters are the third-quarter phenomenon (TQP) and the PT3. The TQP relates to the length of the mission, when the lowest mood occurs around the mid-point of the mission. In Antarctic circumstances, this coincides with mid-winter, and the WOS. The PT3 has physiological, cognitive and behavioural correlates. Essentially, the cold Antarctic environment appears to affect the human endocrinology with an effect on cognition and mood, which, if untreated, appears to be detrimental. The relationship between the physiological, cognitive and behavioural components of PT3, however, is not entirely clear. The relationship between the three symptom clusters also remains in the dark. For this research, the focus will be placed on the two behavioural symptom clusters, the WOS and the TQP. This is because they can be inferred from interview and questionnaire data; and because I, as the data collecting researcher, do not have the medical training to collect blood samples. There is also no medical doctor at the station who could collect those samples on my behalf.

To investigate causal relationships, qualitative data in the form of diaries and interviews has proven itself valuable because it provides insights that closed questionnaires cannot provide. Participants can reflect on their experience and highlight what makes them feel poorly or well at any given time. This is also important because of a lack of literature on salutogenic, or positive experiences in ICE. Research has primarily focused on negative experiences and how to prevent them, but emphasising positive experiences may also facilitate better coping. Therefore, it is crucial to include interviews which offer space for such reflection.

Cognitive impairment has been subjectively complained about as part of the WOS, but empirical evidence is inconclusive about the changes undergone by participants, as well as potential hormonal causes in the PT3. Among executive functions, sustained attention seems to improve with Antarctic residence, and particularly Antarctic winter seems to facilitate reasoning skills. It is interesting that no matrix reasoning or other visually-based reasoning tasks have been used so far. For the current research, this is crucial because the participants and the researcher do not share their first language. Simple reaction time remains robust under Antarctic conditions. This suggests the use of a more complex paradigm for processing speed to avoid ceiling effects. Learning appears to be facilitated by Antarctic residence in accuracy, and recognition improves, too. However, working memory has been shown to worsen during Antarctic residence. All these findings suggest an effect of cold, dark ICE on cognition, but within the High Arctic, research is lacking in these domains. The new approach for investigating them should involve some more intricate memory tests as well as a more complex processing speed test, considering the majority of participants wintering at the station are highly educated scientists.

Consequently, such a novel investigation into the scientists wintering at the Polish Polar Station Hornsund should feature mental health and mood questionnaires, interviews for reflection on personal experiences and cognitive assessment for learning, working memory, processing speed and reasoning skills. This uniquely comprehensive combination of qualitative and quantitative data should reveal any changes that may occur over time, as well as any relationships between these domains. To address any potential issues fully, this will be conducted as a mixed design: there will be an age- and gender-matched control group, as well as a longitudinal assessment of both groups. A longitudinal approach will offer more insight into changes, especially if there are several measuring points. This study will collect cognitive and interview data on three points; during equinox and normal photoperiods, during polar night in constant darkness and during midnight sun, in constant sunlight. The questionnaire data which is more easily administered from afar than cognitive tests will be collected at these three points and at two additional points: just after the participants' arrival and just after the end of polar night.

The insights that this study can offer include knowledge about the adaptation of Polish Explorers as well as knowledge about differences in adaptation between the Arctic and the Antarctic. Using a direct mental health assessment, rather than inferring it from mood, may also provide valuable insights about changes that are yet unknown. For example, new variables to be included in this study are psychoticism, phobic anxiety and paranoid ideation. The comprehensive combination of qualitative and quantitative data is also a rare approach which aims to establish further insight into the causes of potential changes and into positive experiences.

This study is thus exploratory in its nature. It will explore three main areas: the Explorers' fluctuations in mood and cognition over time and in comparison to the controls, the Explorers' personal life experiences at the station, and the question of what makes a good winter candidate. First and foremost are the questions about changes in the polar Explorers over the course of their mission: will the Explorers' mood and mental health change over time; and if so, how? Will the Explorers' cognitive functions change over time; and if so, how? Based on the previous evidence outlined above, I do expect that negative moods and mental health issues will appear most frequently and present most intensely during the polar night in the isolated Explorers. With regard to the cognitive studies, I expect there to be changes in sustained auditory and visual attention, selective auditory and visual attention, cognitive flexibility, reasoning speed and accuracy, as well as visual memory and recognition. The question of whether such changes are normal will be addressed using the control group who will undergo the same cognitive testing and the same questionnaire assessments in the same seasons as the Explorers. If the Explorers' scores differ from the control group, I will be able to infer the effect of the polar seasons. It is possible that learning effects will surface over the course of the study. In order to differentiate learning effects from seasonal effects, the control group will undergo the parallel versions in a different order than the Explorers. Consequently, the collection of this time control group will allow me to infer whether any changes in the Explorers are to be expected independently of the polar seasons and whether learning occurs differently under conditions of ICE. I expect that there will be some differences between the Explorers and their time controls but not across all variables. Little differences have emerged on the rare occasions that home-based control groups were employed (Bell & Garthwaite, 1987; Butcher & Ryan, 1974).

Secondly, the question of the individuals' experience needs addressing. I will interview each participating Explorer before, during and after the polar night to allow them to reflect on their experience and give me insight into their personal views.

Thirdly, questions in relation to the suitability of individual candidates need answering: do personality traits predict whether any given individual suffers more substantial complications in polar night? Which behaviours are most valued by colleagues at the Polish Polar Station? Nearly every personality trait has been implicated in predicting successful Antarctic wintering: highly open people are more likely to be considered well-adapted by their commanders (Grant et al., 2007); those low in extraversion are less stressed (Rosnet et al., 2000) while introverted team members adapt more easily (Palinkas, 1989). For the purpose of this study, the self-reported mood and mental health DV of the winter isolation period will be predicted by self-reported personality traits. This will give insight into how the team members see themselves. With regard to valued behaviours, being friendly and competent at one's job have been considered very desirable (Gunderson, 1973).

2. Methodology

2.1 The Polish Polar Station, Hornsund, Svalbard

Before I present the logistic intricacies of this research process and the methodological details of the study, I would like to introduce you to Svalbard and the Polish Polar Station as the setting of this research. Parts of this chapter have been published as a SAGE Research Methods Case Study (Temp, Lee, & Bak, 2018).

At 77°0’0” North, 15°33’0” East, the Polish Polar Station (often referred to by its location, “Hornsund”) experiences polar night for 104 days: from October 31, to February 11 while the midnight sun rises on April 24, and sets on August 18 (The Norwegian Hydrographic Service, 2017). The station is located on the Northern shore of Hornsundfjord, inside the South Spitsbergen National Park (Zalewski, Górski, Weslawski, Glowacki, & Nowosielski, 2007), a protected area. It lies 136km south of Svalbard’s capital Longyearbyen (norw.: “Longyear City”), with no roads connecting the capital and the station. The Polish Polar Station’s location in the South Spitsbergen National Park means that reindeers, Arctic foxes, polar bears and many bird species live around the station (Elger et al., 2012, p. 156). For more details of Svalbard’s geography, please consult the map in Figure 2.1 below.

Figure 2.1: A Map of Svalbard showing Longyearbyen and Hornsund.

This figure shows the glaciers that cover Svalbard, the main research facilities and, shaded in dark green, *Management Area 10*. Svalbard Airport is situated approximately six kilometres outside of Longyearbyen and Ny-Ålesund Airport is close to the research stations of the same name in King's Bay. Thus, neither airport has its own marker on this map. Svalbard Airport can be reached with regular airline flights from Oslo and Trømso in continental Norway. Ny-Ålesund Airport connects only to Svalbard Airport in Longyearbyen. Hornsund, however, has no airport.

Map courtesy of Anna-Maria Trofaier (Norwegian Polar Institute).

This map highlights the central Management Area 10, the area in which tourists and scientists can move freely because they are under the immediate supervision of the Sysselmannen. This Governor exercises sovereignty over Svalbard on behalf of the Norwegian government and attends to law enforcement, administration and environmental protection on the archipelago. Hornsund, as Figure 2.1 shows, lies outside of Management Area 10. This has consequences for anyone conducting research at Hornsund which are outlined among the Svalbard-specific issues in the next section (the current section primarily deals with the geography and climate of Hornsund). Please see Figure 2.2 below for a photo of the station.

Figure 2.2: The Polish Polar Station, Hornsund, in September 2015.

This photo demonstrates how isolated the station truly is: with the Fugleberget and Ariekammen Mountains to the left and centre, and Hansbreen Glacier to the right of the picture, its inaccessibility becomes visible. To the right, you can see the water of Hornsundfjord which implies that the Greenland Sea lies behind the photographer, encircling the tongue of land on which the Polish Polar Station lies.

Photograph courtesy of Marcin Kaczkan.

It is possible to fly to Svalbard Airport all year round. In summer, the last 136km to the station can be bridged by helicopters, boats, ships, and yachts which anchor approximately 500m into the fjord (Zalewski et al., 2007, p. 93). The passengers can be transported ashore by zodiacs and amphibious vehicles, Figure 2.3 shows an example. There is no port for passengers to go ashore.

Figure 2.3: The supply ship *Horyzont II* anchoring in Hornsundfjord.

This photograph demonstrates the late summer conditions in the fjord: the bright orange *amphibious vehicle* beside the ship is picking up goods and passengers. The waiting passengers can be seen spotted on the ship. They have to climb a rope ladder into the amphibious vehicle, before donning a life vest and climbing into the zodiac in the background, to be taken ashore. The shore and some sea ice can be seen in the far background.

The Horyzont II, depicted in Figure 2.1.3, supplies food, water and technical provisions to the team in late June/early July and September of each year. In June, she also takes the new winter team to the station and takes the previous year's team home. Between October and February, however, the only safe transportation to the station are helicopters (INTERACT station catalogue, 2012, p. p. 157). The Norwegian airline Lufttransport operates two Eurocopter A332 ("Super Puma") on behalf of the Sysselmannen; these are usually reserved for search-and-rescue missions (SAR) or police activities beyond Management Area 10 (cf. Figure 2.1). Figure 2.4 shows one of the Sysselmannen's Super Puma models, LN-OLR.

Figure 2.4: The Sysselmannen's *LN-OLR* Super Puma helicopter.

This model seats the two pilots plus 15 additional passengers. I took this photograph shortly before my flight to Hornsund departed.

These facts demonstrate the remoteness and resultant inaccessibility of the Polish Polar Station in Hornsund. In order to further understand the extremity of its physical environment, I will now outline the climate. Part of the station's scientific duty is collecting weather data; so I will draw on the station's own weather measurements (Mandat, Dabrowska, & Wawrzyniak, 2015, 2016a, 2016b, 2016c).

Climate at the Polish Polar Station During This Study

Firstly, it is crucial to understand the abnormality of Hornsund's photo periods. Please consult the graph in Figure 2.5 below for a numerical graph and the photographs in Figure 2.6 for a visualisation.

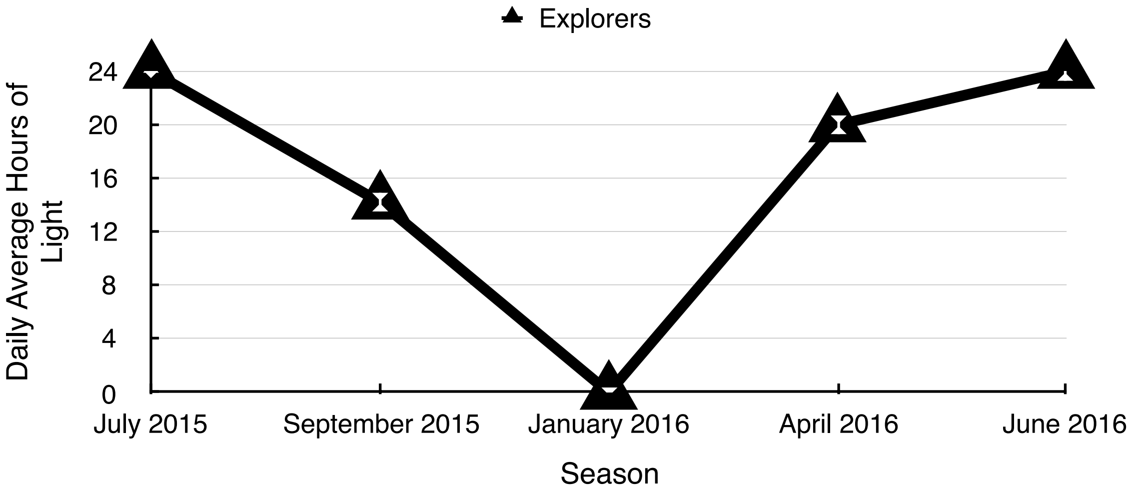

Figure 2.5: The Variation in Hours of Daylight in Hornsund.

This Figure shows the daily average of the hours that the sun spent above the horizon during each of our testing months *("Daylight")*. In July 2015 and June 2016, the average was 24hrs per day with a SD of 0, while in January 2016 it was 0hrs per day with a SD of 0.

Figure 2.5 offers two photographs, one each from my visits in January 2016 and June 2016 respectively. This is to give a better understanding of what the abnormal photoperiods really mean. The first photograph in Figure 2.2 above shows the Polish Polar Station on 25 September 2015, at 9:57 o'clock.

During this time, the photo-period was normal with a daily average of 14.22hrs (SD 2.08hrs). Compare this to Figure 2.6 below.

Figure 2.6: Light Conditions in Hornsund in January 2016 and June 2016.

The upper photo shows the station buildings on January 28, 2016 at 14:09 o'clock. You can see a shimmer of sunlight in the far background but this is the so-called *civil twilight:* the sun is merely 6 to 0 degrees below the horizon, allowing viewers to distinguish the horizon clearly. That day was the first time that our participants caught a glimpse of sunlight after the sunset on October 31 and the end of civil twilight on November 18, 2015. The lower panel, on the other hand, was shot on June 3, 2016 at 23:27 o'clock. As you can see, the sun is clearly above the horizon. It is noteworthy that this photo shows Hornsund from aboard the yacht *Eltanin* while it is anchoring in the fjord.

Additionally, Hornsund's temperatures can be found in Table 2.1.

Table 2.1.

The Average Monthly Temperature at the Polish Polar Station During This Study.

Centigrade	July 2015	September 2015	January 2016	April 2016	June 2016
max.	15.6	6.8	5.2	2.5	9.6
mean	5.5	2.5	-2.4	-5.0	3.8
min.	1.8	-2.8	-9.9	-15.1	0.6

Table 2.1 shows the average daily temperature of each month of data collection. As a measure of dispersion, maximum and minimum degrees centigrade of each month have been included. It can be seen that April 2016 was the coldest month, despite having an average of 20 hours of sunlight (SD 3.16) already, as per Figure 2.5 above.

The Interior of the Polish Polar Station

In 2007, the station was modernised comprehensively: it now features 13 single rooms, seven bunk rooms, a kitchen, a dining room, a sitting room, eight laboratories, a communication centre, an outpatient clinic, four bathrooms and four toilets, plus stores for food and equipment ("magazyny"). In summer, water is drawn from a nearby pond but in winter, ice and snow need to be melted. Electricity is provided by one electric and two diesel generators (Zalewski et al., 2007, p. 89).

There are eleven wintering crew members ("winter team") at the station: three geophysicists, two meteorologists, two environmental observers (oceanographer, seismologist), one electronic engineer, one mechanic, one electrician and the station commander (Glowacki, 2016). Each winter crew member occupies one of the single rooms, the summer team share the aforementioned bunk rooms. These bunk rooms bring the total number of beds to 36 (INTERACT station catalogue, 2012, p. 156). This means that during the summer of 2015 the maximal amount of people at the station was 36: 11 winter team members plus 25 summer team members. Of these 25, one is a cook and one is an assistant cook. These provide food to all occupants during the summer while in the winter, the 11 winter team members rotate cooking duties. The summer team's size and composition vary from week to week depending on which scientists have been granted permission to conduct research at the station. Additionally, there is a fitness room (INTERACT station catalogue, 2012, p. 156).

The *winter team* is delivered to the station by *Horyzont II* each year in late June or early July. The winter team remains at the station until the following June/July. The team members cannot go home or receive visitors at any point during the winter: usage of the Super Puma helicopters is strictly limited to medical emergencies. This is in stark contrast with their multinational colleagues at Ny-Ålesund's research stations because Ny-Ålesund Airport is connected to Longyear City by two or more weekly flights throughout the year (INTERACT station catalogue, 2012, p. 24). In contrast, the Polish Polar Station remains entirely isolated from the outside world.

The *summer team* is delivered by Horyzont II at the same time as the winter team. This team brings with it two additional cooks who look after the entire station during the summer. However, when Horyzont II arrives again in September of each year, the summer team is taken home to Gdynia, Poland, while the winter team remains behind among themselves.

At the beginning of the 2015/2016 expedition, the station also had two Alaskan husky-malamute mixed-breed dogs, "Brzydal" and "Ragna". Their purpose was to warn the crew of polar bears and provide company. For the 2015-2016 expedition, the station leader brought his personal Greenland dog ("Rudek"), too. After a litter of five puppies was born to Ragna and Rudek in November 2015, eight dogs populated the station compared to eleven humans. One of the puppies ("Yuki") remained at the station with her mother and Brzydal, the other four ("Harpa", "Aura", "Bjørn" and "Biegun") were adopted by my research participants and taken to Poland. These adoptions show how much the company of dogs meant to my participants over the course of their expedition.

Having demonstrated the isolation, the extreme photo periods, the cold and the social station environment, I will now outline how these impacted the research project and research methodology over its course as a result of these abnormalities.

2.2 Svalbard-Specific Research Issues

Aspects of Lugg's (1991, p. 38) A-Factor that I had to address for my PhD were a sample size of ten, very busy participants, technological complications and difficult accessibility in polar night.

The issue of small sample size is addressed in detail in the statistical section at the end of this chapter. Essentially, I will combine traditional classical methodology, Bayesian statistics and case study methodology to ensure the relatively small sample size is analysed appropriately.

The occupation of my participants with their own work was addressed by allowing myself sufficient time at the station: a week in September 2015, two weeks in January 2016 and two weeks in June 2016. Additionally, I kept the in-person assessment as short as possible: 60 minutes of testing plus interview time at the participants' discretion.

The problem of accessibility was more difficult to solve. The Polish Polar Station does have satellite internet but this can be very unreliable in Arctic blizzards. Even in the summer when the weather is better, up to 36 people use this network, making the connection vulnerable. In July 2015, I attempted to collect questionnaire data online which frustrated everyone: my participants would fill in a questionnaire, only to have the internet disconnect and their work deleted, leaving me with incomplete data. So I concluded that I would leave hardcopies of the questionnaires behind at the station for future data collections. Fortunately, the IGF offered me a place on the Horyzont II, from Gdynia, Poland to Hornsund, Svalbard in September 2015. This journey allowed me a whole week's time at the station during which I conducted neuropsychological examinations, mental health questionnaires and interviews before the beginning of polar night in late October 2015.

For the polar night testing that was planned for January 2016, I also had to reach the station. Antarctic crews are so isolated that evacuation may be delayed by several months because it is deemed too dangerous in polar night, even in the case of a cancer diagnosis (Kumar & Duong, 2012). The Polish Polar Station is somewhat more accessible via helicopters, if the weather permits it. In order to avoid travelling to Hornsund in winter in person, I had attempted to recruit the eleventh crew member who had withdrawn from my study (see 2.4) to conduct the assessments on my behalf. However, he had declined. For January, I had planned on hiring one of the Governor's Super Puma helicopters (see Figures 2.1 and 2.4) to cover the 136km from Svalbard Airport to Hornsund. Hiring such a helicopter requires a helicopter landing permit: all research projects must be registered on the ResearchInSvalbard forum where researchers can also announce their field work outside of Management Area 10 and apply for a helicopter landing permit. In order to secure a landing permit, researchers have to demonstrate their caution and understanding of Svalbard's nature: how they will handle vegetation and animals, how they will look after their own waste products and excrements and how they will deal with cultural heritage sites. They will also need to justify their use of the helicopter. The Governor of Svalbard offered me to join the helicopter rescue team on a training mission at a reduced price: they would drop me off at the station and continue to practise a manoeuvre. However, as I arrived in Hornsund, it turned out that one of my participants urgently needed to go to the hospital in Longyearbyen. This resulted in their health insurance covering the remaining helicopter costs (see below for details about health insurances on Svalbard). For my final testing point in June, it was possible to rent a small yacht to travel to Hornsund. The Eltanin is partly visible in Figure 2.1.6 above.

While all this is in accordance with Lugg's (1991, p. 38) A-Factor, I would like to add a specific Arctic issue that is entirely absent in the Antarctic: ursus maritimus, the polar bear. Svalbard is estimated to have a higher polar bear population than human population and polar bears pose a significant threat to human life (Norwegian Polar Institute, 2005). People on Svalbard need to be constantly vigilant of the presence of these large predators. Carrying a fire arm with a calibre large enough to kill a polar bear is a legal requirement (Norwegian Polar Institute, 2005). This in itself adds two aspects to what I call the "S-Factor" ("Svalbard-Factor"): in addition to all the aspects of the A-Factor, researchers and participants are constantly in danger from polar bears, so they have to handle guns – a uniquely Arctic stressor entirely absent in Antarctica. This requires a specific safety training and also a psychiatric evaluation before being appointed.

Due to these circumstances, the normal European Health Insurance Card (EHIC) which grants any European Union (EU) citizen healthcare in mainland Norway does not cover accidents or illnesses that may befall any person outside Svalbard's Management Area 10. To leave Management Area 10, a Search and Rescue (SAR) insurance is needed: it must cover up to 200.000NOK for SAR missions and the conveyance of patients even if the accident or illness happens due to recklessness or negligence of the patient (The Governor of Svalbard, 2017). I conferred with my German EHIC provider, Barmer GEK, and bought an additional insurance policy from HUK-Coburg.

2.3 Study Design

This study was a correlational design in which real world phenomena were observed. There were four independent variables (IV) in this study; one was between-subjects and three were within-subjects.

2.3.1 Independent Variables

Between-subjects IV: Group

The only between-subjects IV was Group, with the levels "Explorers" and "Controls". The Explorers were the members of the 38th Polish Polar Expedition and were tested between July 2015 and June 2016 at the Polish Polar Station, Svalbard; the Controls continuously resided in Edinburgh, Scotland, and were tested from June 2016 to June 2017. The control groups were age-, gender- and education-matched.

Within subjects IV 1: Mission Time

Mission Time was the within-subjects IV with different levels corresponding to the polar seasons on Svalbard, please consult Figure 2.3.1 below. This IV served only to compare the Explorers to themselves across time and was not applied to any other Group because no other Group underwent Mission Time. Figure 2.7 below is adapted from Figure 2.5 in

Section 2.1 above but adjusted for the IV Mission Time instead of reflection months.

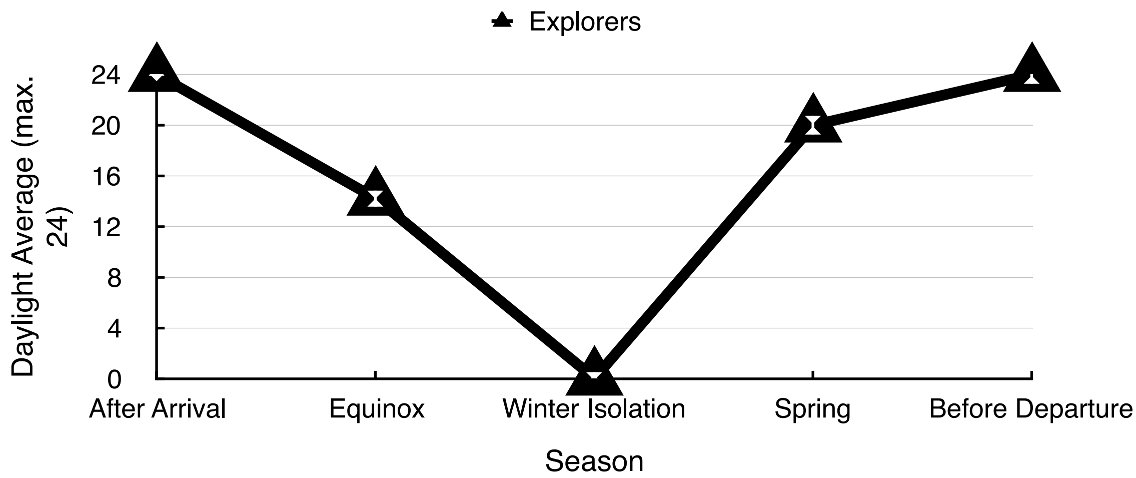

Figure 2.7: The Average Daylight in Hornsund.

"Daylight" refers to the amount of time the sun spends above the horizon regardless of whether it is cloudy or not. The polar seasons for the Explorers corresponded to the calendar months as follows: July 2015 (*After Arrival*), September 2015 (*Equinox*), January 2016 (*Winter Isolation*), April 2016 (*Spring*) and June 2016 (*Before Departure*).

In Figure 2.7, After Arrival and Before Departure were conducted during the polar day ("midnight sun") when the average daylight is 24 hours per day and the standard deviation (SD) from this is zero because the sun never sets. During the Explorers' Equinox the average amount of daylight was 14.22 hours per day or 14hrs 37min which was comparable to the Controls. The SD from this was 2.08hrs (2hrs 5min). Spring had exactly 20 average hours of daylight with an SD of 3.16hrs (3hrs 10min). Winter data was collected during polar night, so the sun did not rise above the horizon for this period, bringing the average hours of daylight for this period to zero with an SD of zero.

Which assessments were possible for the Explorers depended on whether or not I, as the researcher, was physically present at the station: on the three occasions where I was at the Polish Polar Station in person, I collected cognitive, mental health and interview data myself. On two additional occasions, the Explorers filled out questionnaires without me. Subsequently, the Mission Time analyses for cognitive and interview data feature only three levels and the Mission Time analyses for mood and mental health questionnaires feature five levels. Please consult Figure 2.8 for a graphic representation.

Figure 2.8. The Mission Time Levels Collected at the Polish Polar Station.

In September 2015 (*Equinox)*, January 2016 (*Winter Isolation*) and June 2016 (*Before Departure*), I personally collected cognitive, mental health, mood and interview data. In July 2015 (*After Arrival*) and April 2016 (*Spring*), the Explorers filled the questionnaires out independently of me. That is why Mission Time has five levels for the analysis of mood and mental health data but only three for cognition and interviews.

It was not logistically possible to test the Controls perfectly simultaneous to the Explorers because of the time it took to reach the station and return. That is why there is a different within-subjects IV to compare Controls and Explorers.

Within-subjects IV 2: Season

The Controls were still assessed around the same calendar months but in the year after the Explorers. The majority of Controls began their testing right after the Explorers had finished; so their seasonal pattern was as illustrated in Figure 2.9 below.

Figure 2.9. The Season IV of the Controls.

Here, the levels are collected in June 2016 (*Summer 1*), August 2016 (*Summer 2*), September 2016 (*Equinox*), January 2017 (*Winter*) and April 2017 (*Spring*).

However, this study ran into major recruitment issues for Controls: to find 10 willing and matching persons took from October 2015 until September 2016 which, for details see Figure 2.12 below and Section 7.7. Due to this, Controls completed the two summer measurements in the same year. At the time this research was planned, there was no reason to expect differences in mood and mental health between the summers of 2016 and 2017, so both summer levels were collected early and late in the summer of 2016. The limitations of this approach are addressed in Section 7.7. Comparing the Explorers and the Controls across different seasons will give insight into potential variation between groups over time, as illustrated below the following statistical comparisons will be made.

Summer 1	Equinox	Winter	Spring	Summer 2
• E: July 2015 • TC: August 2016	• E: September 2015 • TC: September 2016	• E: January 2016 • TC: January 2017	• E: April 2016 • TC: April 2017	• E: June 2016 • TC: June 2016

Figure 2.10. The Seasonality Comparisons between Explorers and Controls. This shows how the Seasonality levels will be arranged to allow for seasonal comparisons of our Explorers and Controls.

Figure 2.11 below shows the average daylight between the different Groups. As can be seen, the Controls in their home environment experienced much more stable light conditions. For the Season IV, the data points which were closest in light conditions were compared between Groups. This figure is adapted from Figures 2.5 and 2.7 above but adjusted to accommodate the Controls as well as the Explorers. Its first level has been renamed from “After Arrival” to “Summer 1” to reflect Season rather than Mission Time since the Controls did not move during the observation period.

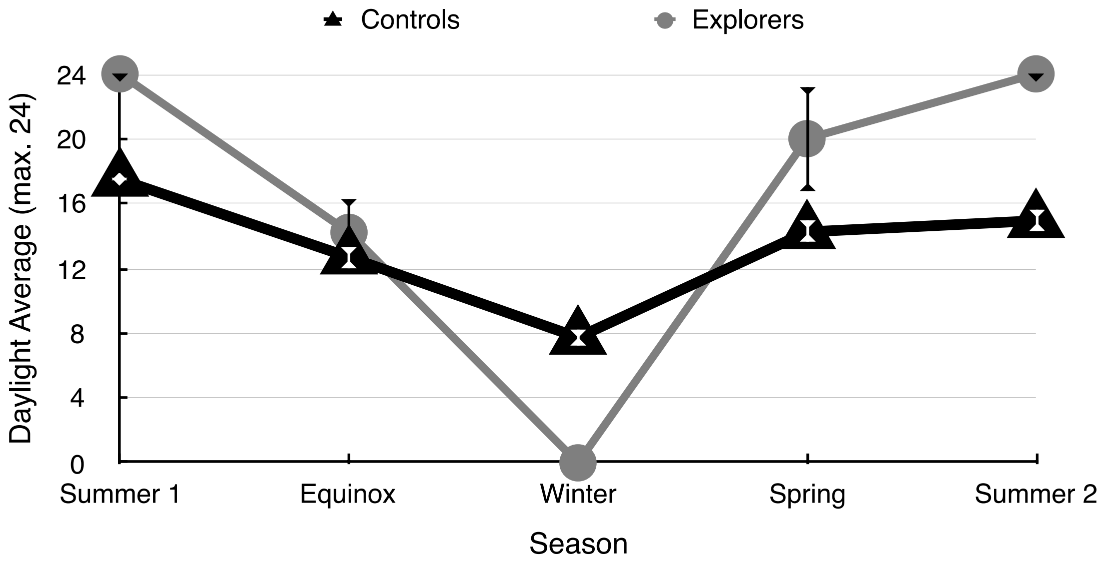

Figure 2.11. The Average Daylight Exposure of Controls and Explorers.

The Controls experienced 17.49 hours of daylight in *Summer 1* (June 2016, 17hrs 29min) with an SD of 0.12hrs (7min); 12.69hrs at *Equinox* (September 2016, 12hrs 41min) with an SD of 0.67hrs (40min); 7.74hrs during *Winter* (January 2017, 7hrs 44min) with an SD of 0.46hrs (28min); 14.25hrs in *Spring* (April 2017, 14hrs 15min) with an SD of 0.66hrs (40min) and finally, 14.94hrs of daylight in *Summer 2* (August 2016, 14hrs 56min) with an SD of 0.64hrs (38min).

However, there is one particular difference to be wary of: learning behaviours. So far, changes over time on polar missions have largely been attributed to mission time passing and/or seasonal fluctuations. Mission time passing is accounted for in the Mission Time IV applied only to the Explorers and seasonal fluctuations are analysed using the Seasonality IV between Explorers and Controls. However, it is also possible that ICE conditions affect the Explorers' learning behaviour. In order to assess this, the within-subjects IV "Testing Time" was created.

Within-subjects IV 3: Testing Time

For this IV, the collected data was re-arranged by learning time. The above Figure 2.10 shows that for Season, the Explorers' third cognitive assessment was compared to the first assessment of the Controls because both took place in June 2016. To investigate possible learning effects which may differ between Groups, the data was re-arranged in the following format.

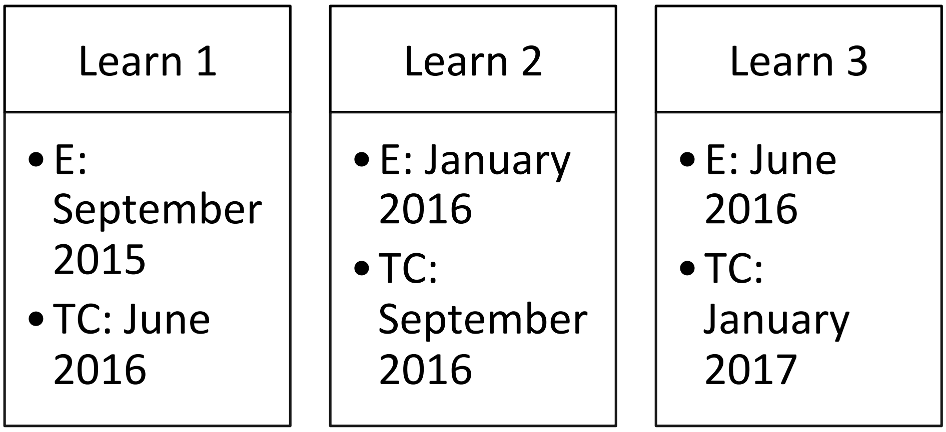

Figure 2.11. The Re-Arrangement of the Data for the Testing Time IV.

Figure 2.11 shows that because the Groups started at different times, their data had to be re-arranged to account for learning effects. This way, it is possible to observe if learning occurs differently under conditions of ICE than it would do under normal conditions. "Learn" 1, 2, and 3 correspond to cognitive Testing Time 1, 2, and 3.

This re-arrangement also allowed to include the re-arrangement of the Control data because there were two controls who started in the winter of 2015 (concluding in September 2016, rather than January 2017) and one control who signed up in September 2016 (concluding in June 2017 rather than January 2017). This was the case because the control study ran into major recruitment issues as will be outlined in the limitations in the final chapter (Section 7.7).

2.3.2 Dependent Variables

Each cognitive instrument provided several dependent variables (DV), all of which are presented in Table 2.2 while the questionnaire assessment DV are presented in Table 2.3 below.

Table 2.2

Overview of the DVs Derived from the Cognitive Assessments.

Instrument	Derived DV
Figural Learning and Memory Test "Visual Memory"	1. Total Number of Correctly Learned Items ("FLMT Total") 2. Correctly Recalled Items after Short Delay ("FLMT SD") 3. Correctly Recalled Items after Long Delay ("FLMT LD") 4. Correctly Recalled Interference Items ("FLMT Interference") 5. Confabulations ("FLMT Confabulations") 6. Rotations ("FLMT Rotations") 7. Perseverations ("FLMT Perseverations") 8. Correctly Recognised Items ("FLMT Recognition") 9. False-Positively Recognised Items ("FLMT FP-Recognition")
Raven's Standard Progressive Matrices (SPM) "Logical Reasoning"	1. Number of Attempted Items ("Reasoning Speed") 2. Accuracy Percentage ("Reasoning Accuracy") 3. Mistakes ("Reasoning Failure") 4. Skipped Items ("Reasoning Skip Rate")
Sustained Attention to Response Task (SART) "Visual Attention"	1. Correctly withheld response ("SART Accuracy") 2. Response Time for Go Trials ("SART RT") 3. Coefficient of Variation ("SART CV")
Test of Everyday Attention (TEA) "Auditory Attention"	1. TEA Task 2 ("Sustained Attention") 2. TEA Task 3 ("Selective Attention") 3. TEA Task 5 ("Cognitive Flexibility")

Table 2.2 shows that the four cognitive instruments yielded a total of 18 DV, offering a comprehensive insight into cognitive fluctuations between Equinox, Winter and Summer 2.

Table 2.3

Overview of the Mood and Mental Health DVs.

Instrument	**Derived DVs**
Profile of Mood States (POMS)	1. Anger 2. Depression 3. Tension 4. Confusion 5. Vigor 6. Total Mood Disturbance (TMD)
Symptom Checklist-90-Revised (SCL-90-R)	1. Somatization 2. Obsessive-Compulsive Behaviour 3. Interpersonal Sensitivity 4. Depression 5. Anxiety 6. Hostility 7. Phobic Anxiety 8. Paranoid Ideation 9. Psychoticism 10. Global Severity Index ("GSI") 11. Positive Symptom Distress Index ("PSDI") 12. Positive Symptom Total ("PST")

Table 2.3 shows the total of 18 mood and mental health DVs collected during this study. The mood and mental health DVs were assessed at all Mission Time (Well-Being) levels: Summer 1, Equinox, Winter, Spring and Summer 2. Tables 2.2 and 2.3 provide lists of the DV; to find out more about the instruments themselves, please go to Section 2.5.

The DVs which were assumed to be stable were only measured once. These DVs focused on getting a better understanding of the Explorers and Controls. They featured the Seasonal Pattern Assessment Questionnaire (SPAQ) to check for seasonal affective disorder (SAD). Furthermore, the Morningness-Eveningness Questionnaire (MEQ) was employed to determine when participants felt most alert or most sleepy and investigate their circadian rhythms. Personality was assessed using the NEO-Five Factor Inventory with the domains Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. Now, the participants from all Groups will be introduced.

2.4 Participants

The Explorers were ten out of 11 winter team members of the 38th expedition to the Polish Polar Station, Hornsund. Three (n=3) Explorers were female. Konstantyn initially consented but then withdrew due to discomfort with the questionnaires. Albert aborted the mission and returned home in March 2016 but remained available for further participation.

The Controls were drafted from the University of Edinburgh staff and student population, Edinburgh's general population, and the University's Older Adult Healthy Volunteer Panel. Participants are introduced in Table 2.4. below.

Table 2.4.

The Demographic Background of the Explorers and the Controls.

Demographic Variable	**Explorers**	**Controls**	**Total**
Age	33.10 (10.80)	31.7 (8.84)	33.50 (9.53)
Sex	3 women, 6 men		
Years of Education	11.9 (1.85)	12.33 (2.45)	12.28 (2.02)
Marital Status			
Single	4	3	7
Unmarried relationship	4	2	6
Married	1	3	4
Divorced	0	1	1

Demographic Variable	Explorers	Controls	Total
Thyroid Status			
Hypothyroidism	1	0	1
Hyperthyroidism	0	0	0
Healthy thyroid	9	10	19
Depression Status			
Past depression	1	0	1
Current depression	0	0	0
No depression	9	9	18

None of the Explorers had ever worked in Antarctica, but 40% (n=4) had previously worked at Hornsund. The duration of their stays ranged from two to 52 weeks (M=18.86, SD=26.46); the only person who had previously stayed for 52 weeks was the team leader Karol. Previous winter experience was a prerequisite for his position. He had been to the Polish Polar Station six times, including one wintering. Maria had been to the station three times, and Albert and Teo had been to the station once. Maria had previously suffered from depression and Julia was being treated for hypothyroidism during the expedition. There were no differences in age or education between the Explorers and the Controls; altogether the Controls were slightly healthier because there were no cases of past depression or hypothyroidism amongst them.

Figure 2.13 shows when each Explorer was present at the station.

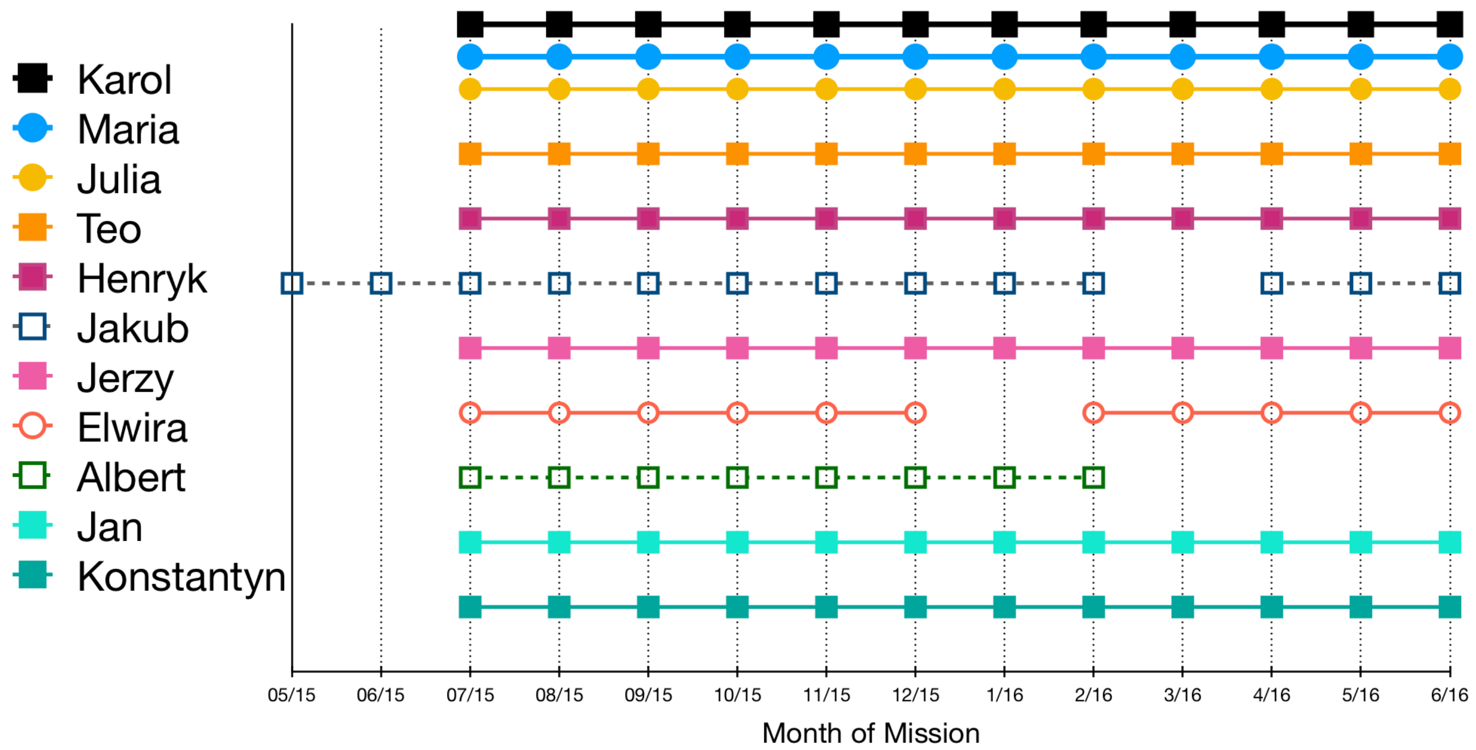

Figure 2.13: The Absences of Each Individual Participant.

Male Explorers have square markers, female Explorers have round markers. The markers are filled for participants who were present for the whole mission. Henryk and Elwira had mid-mission hospitalisations and Albert aborted the mission in early March.

2.5 Materials

2.5.1 Neuropsychological Instruments

The conclusion from Section 1.5.2 was that sustained attention, reasoning skills, processing speed, learning, and recognition are very prone to change during prolonged Antarctic residence. Here, the respective instruments to be used in our Arctic study are introduced. As demonstrated in Section 2.4, our participants are highly educated so to avoid ceiling effects, tasks with higher levels of complexity than described in Section 1.4.2 were chosen.

Figural Learning and Memory Test (FLMT). This list learning test has two versions: List A and List B. The participants are presented with either list of 15 geometric designs. They are instructed to memorise these items across five learning trials. The list is considered learnt once the participant has remembered all 15 items correctly in two consecutive trials, otherwise the fifth trial is the last one. Then, an interference list ("List I") with 15 different items has to be learnt and recalled by the participant, followed immediately by the request to recall and draw the 15 original items ("short delay"). Thirty minutes later, the participant is asked to recall the original items once more ("long delay"), before being offered a recognition sheet. This sheet showed a total of 30 items: List A mixed with List B. Participants had to recognise which items they learnt and drew.

Throughout the list-learning, several possible mistakes may be made. Participants may produce a confabulation which is an item they think they remember but which is not actually on the list. The first time when such an item is “remembered” it is marked as confabulation. Subsequently, if it is reproduced at the cost of a correct, actually presented item, this is considered a perseveration. An item which is so severely distorted that it can no longer be recognised is considered a distortion. Items which are reproduced upside-down or mirrored are considered rotations. If the same item is reproduced repeatedly as a rotation these items are still considered rotations, not perseverations in order to distinguish between an item whose only fault was its rotation and an altogether confabulated item that was not presented at all, according to one of the test’s developers (Balzer, 2016, personal communication).

Sustained Attention to Response Task (SART). The SART provides a challenging attention paradigm: serially, single digits from 1 to 9 are presented in a randomised order, with the digit 3 being the no-go target. This means that the participants had to press the space bar as fast as possible when any digit except 3 was presented on-screen. The digits’ font size varied randomly from 12 to 29mm. This variation’s purpose is to maximise the participants’ processing of the digital value, and to minimise the chance of automatic processing based on the stimulus. Each digit presentation lasts 250ms, followed by a 900ms mask in the inter-stimulus interval. In this version, each digit was presented 25 times, so the total number of trials was 225 with a 0.11 probability of a 3 occurring. The SART’s complexity arises from the necessity to be fast when the presented digit differs from 3 (“go trial”), and appropriately withhold pressing the space bar when the digit 3 is presented (“no-go trial”). This task takes approximately four minutes.

Test of Everyday Attention - Auditory Elevator Tasks (TEA). During these three tasks, participants are asked to imagine that they are in an elevator whose floor indicator does not work. They are then presented with tape-recorded tones and have to count the number of tones to find out which floor they are on. First, the elevator begins on Floor 0 and each tone indicates that it has moved up a floor (Task 2). Participants have to count these tones and state out loud how many they counted whenever the tape asks “How many?”. Task 3 presents a series of higher tones mixed in with the previous tones. These higher tones serve as distractors, so the participants are instructed to ignore the high tones while counting the low tones. Task 5 features high, neutral, and low tones. In this task, high tones indicate that the elevator changes direction to go up and low tones indicate that the elevator changes direction to go down. The neutral tones indicate the amount of floors the elevator moves in either direction. Here, the tape asks “Which floor (have you just arrived at)?” instead of “How many (tones did you count)?”. Not including the instruction time which varies inter-individually, the TEA takes about 15 minutes. Combined, these tasks assess auditory WM, sustained attention and cognitive flexibility (Robertson, Ward, Ridgeway, & Nimmo-Smith, 1996). The TEA has three versions (A, B, C), making it suitable for testing before, during and after polar night.

Raven’s Standard Progressive Matrices (SPM). Here, participants are presented with a matrix puzzle from which one piece is missing. In the usual procedure, participants are given unlimited time to solve the entire booklet. However, I restricted their processing time to seven minutes because I wanted to make this task more difficult for our highly-educated participants. Time-limited versions of the SPM have been used previously (Ooi, Goh, Sorace, & Bak, in press). It was also necessary to limit the testing time because of the numerous station duties each member had to carry out. The SPM have a parallel version. The SPM were chosen over the advanced version because the SPM have a parallel version and the advanced version does not. This enabled the repetitive testing while minimising practice effects.

2.5.2 Questionnaire Instruments

Profile of Mood States 2 - Brief Version (POMS). The POMS has produced seasonal fluctuations in several Antarctic studies (Palinkas, Glogower, et al., 2004; Palinkas & Houseal, 2000; Peri et al., 2000; Reed et al., 2001; Xu et al., 2003). It was selected to facilitate easier comparisons to Antarctic evidence. Nevertheless, mental health can merely be inferred from it because it primarily measures mood states. The chosen version features 30 items which are rated on a five-point Likert scale ranging from 0 (“not at all”) to 4 (“extremely”). From these items, the subscales of tension-anxiety, anger-hostility, fatigue, confusion-bewilderment, depression-dejection and -activity are constructed. They are then combined into a total mood disturbance score (TMD). The POMS can be used to rate the moods “over the past week” or “right now”; our participants were instructed to rate their moods “right now”.

Symptom Checklist-90 Revised (SCL-90-R). With 90 items, the SCL-90-R is a comprehensive mental health assessment. Participants indicate how much any given symptom has distressed them over the past week on a five-point Likert scale, from 0 (“not at all”) to 4 (“extremely”). From these items, the following subscales are derived: somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. Additionally, the *Global Severity Index (GSI)* gives insight into the amount of symptoms and intensity of the perceived distress. The *Positive Symptom Total (PST)* is the number of symptoms experienced by the participant (max. 90) and the *Positive Symptom Distress Index (PSDI)* offers an understanding of how intense the symptoms are.

Peer Nomination Items. This questionnaire was presented by Gunderson (1973, p. 357). Asking small teams at isolated Antarctic stations to evaluate each other’s performance is likely to result in compliance issues because team members are unwilling to disclose any negative views of their colleagues. This questionnaire is the only one that focuses on positive personal qualities. Since it was last used in 1973 and Antarctica was purely a male domain until the Australians allowed their first women onto the continent in 1975 (Collis, 2009), I adapted it to ask participants to list “persons” rather than “men”. The questionnaire requests participants to list five persons who were most knowledgable, hardest working, calm in emergencies, friendliest or most popular, had the hardest job, and whom they would choose for another wintering. Additionally, it asks participants to describe a person whom they feel they do not really know and if they had a false first impression of someone.

2.5.3 Interviews

The above questionnaire assessments focus heavily on negative symptomatology and experiences but because there is clear evidence that some experiences are highly positive (Crocq et al., 1973, p. 362; Taylor, 1973, p. 227; Oliver, 1991, p. 223; Wood et al., 2000) I decided to include interviews. These interviews were phenomenological in nature, meaning they focused on the Explorers' personal lifeworld and experiences in an attempt to shift away from my personal preconceived notions about polar environments and experiences. Larkin, Watts and Clifton (2006) point out that even though it would be desirable to collect and analyse data without any preconceived notions, this is an unrealistic goal in phenomenology. Phenomenology focuses very much on "persons-in-context" (Larkin et al., 2006, p. 108) and thus must always consider both: participant and researcher, as a person-in-context. According to Larkin et al. (2006), the successful phenomenologist appraises his or her own epistemological and methodological shortcomings when making the most sensitive and responsive effort possible. For each testing point, I chose one opening question that was identical for all participants. At Equinox, I asked them "What is extreme about this environment?"; in Winter "What has changed?" and in Summer "How have you changed?". The Winter question focused more on the environmental changes while the Summer question focused on personal development. This was done to investigate changes. I used Interpretative Phenomenological Analysis (IPA) to analyse the interview data. My own preconceived notions in regard to polar experiences are highlighted in Chapter 6.

During the interview, the participant is given room to make sense of all their experiences; the researcher aims to put themselves and their ideas about the subject that being talked about aside in order to find out what is meaningful to the participant. The goal is to understand how a certain phenomenon has been understood by this participant, and what this phenomenon means for this person, in this context (Larkin et al., 2006, p. 117). Once the interview has finished, the researcher explores, describes and interprets the participants' account. Details on the analytic strategy can be found in Section 5.3, followed by the results in Section 5.4.

2.6 Procedure

The Explorers were given their questionnaires in envelopes labelled with their research identification number (research ID). They were instructed to fill them in whenever they found time and indicate the date on the questionnaires. If they forgot to do so, the date on which they returned their questionnaires was noted. The controls were given their questionnaires and left alone in the testing room to fill them in, the researcher was waiting outside. They were instructed to fetch the researcher once they had completed their questionnaires. This was done to maximise the comfort and privacy of the participants. Following this, the neuropsychological assessments were conducted. They always began with the learning phase of the FLMT, because this test featured a 30 minute delayed recall. During this delay, the SART (4min), TEA (15min) and SPM (7min) were conducted. Then, the delayed recall and recognition were conducted. Finally, the interviews took place. For the Explorers, interviews and cognitive assessments were sometimes conducted separately to accommodate for their station duties and work life. None of the Controls were interviewed.

During the FLMT, participants were instructed that it was not relevant in which order they remembered the items and that they could take as much time as they would need to complete each learning trial. However, they were asked not to invent items of their own, not to rotate or mirror the presented items and to distinguish between dots and circles when drawing the items from memory. If a participant recalled all 15 items correctly before the fifth trial, they were told that these items were correct and that they would have to see and recall the items for one additional trial to complete the learning phase. If they correctly recalled all 15 items on two successive trials, the learning phase was terminated and they were assured that they would be given full marks for the skipped learning trials. Then, the interference list was presented, followed by the SD.

After this, they were given the booklet for the Raven SPM. Here, they were told to say the number of the correct solution out loud so that it could be written down by the researcher, and that they would only have seven minutes to complete as much of the booklet correctly as possible. They were instructed to say "skip" if they wanted to skip an item and to indicate the item's identification number as well as the solution if they wanted to correct an item that they had previously given a wrong answer for. The seven minutes were timed using a countdown on a phone. If a participant completed the entire booklet before the seven minutes were up, they were given an additional booklet to solve.

Following this, they were presented with the SART on a 15' MacBook Pro. The SART was explained to them verbally but there were also written instructions on the screen. The participant launched the SART at their own convenience by pressing the space bar. Initially, they completed some practice trials during which the computer screen reported feedback when mistakes were made. After the practice trials, the instructions screen came up once more and they had to press the space bar again to launch the study trials.

Afterwards, the TEA's Elevator Tasks were presented. The TEA's handbook gives advice on how to instruct this test but only in combination with other tests I did not use. The instructions I gave for Task 2 and 3 are identical to the description above in Section 2.5.1: for Task 2, participants were told to count the tones and for Task 3, they were told to count the same tones while ignoring the mixed-in, higher-pitched tones. Whenever the recording asked "How many?" they had to say out loud how many tones they counted. Task 5, however, was challenging to explain to my non-native English-speaking participants. They were told that the elevator could never go below zero so that the first tone would always be the first floor. The tape recording would now ask them "Which floor [have you arrived on]?" instead of "How many [tones did you count]?". They were asked to imagine that hearing the high-pitched tone meant that someone further up had pressed the button to call the elevator so that any normal-pitched tones would indicate arrival at a higher floor. The lower-pitched tones, however, meant that someone downstairs had called for the elevator so that any normal-pitched would now indicate their arrival at a lower floor. If the participant struggled to understand these verbal instructions, I visualised them using my hands: I would raise my hand from the table and say “Normal tone, first floor.” and then raising it again, saying “Normal tone, second floor.”. Then I would say “Higher tone, so the direction is up.” and use my other hand to point upwards. Then I would say “Normal tone, third floor.” and continue to the seventh floor. There, I would say “Lower tone, so the direction is down.” and point downwards with my free hand. After this, I would count backwards saying “Normal tone, sixth floor. Normal tone, fifth floor”.

Finally, the participants were asked to recall and draw the 15 items of the FLMT once more. Once they had drawn as many designs as they could remember, they were given the recognition sheet and asked to tick the 15 items from the learning trials.

As stated previously, the FLMT, TEA and SPM have several versions allowing for repeated testing without practice effects. The SART does not require a parallel version because each administration presents its digits randomly, the only common aspect is that the no-go target is always the digit 3. Please see Figure 2.14 for the order in which the tests and their parallel versions were used.

Figure 2.14: The Order of Tests in both Groups.

The Explorers began the study in September 2015 with FLMT List A, the original version of the SPM and TEA Version A. Three months later, in January 2016, they continued with FLMT List B, the parallel version of the SPM and TEA Version B. Further five months later, in June 2016, they repeated FLMT List A and the SPM original version with TEA Version C.

The Controls began the study in June 2016 with with FLMT List A, the original version of the SPM and TEA Version A. Two months later, in September 2016, they continued with FLMT List B, the parallel version of the SPM and TEA Version B. Finally, they concluded with FLMT List A, the original SPM and TEA Version C.

All participants apart from Jerzy spoke English well enough to understand the test instructions in English. Jerzy chose a team member as an interpreter for his interviews and his instructions. During the September measurement, this was a temporary Polish visitor to the station, in January it was Maria and in June it was Elwira. All Polish participants were offered translations of the questionnaires and consent form.

2.7 Ethical Considerations

All participants volunteered for this study. They gave informed consent prior to participation and were aware that they could withdraw at any time without unpleasant consequences, so their data would be deleted. The Controls were paid GBP8 per hour, the Explorers however had little use for money and requested that I spend their earnings on fresh produce to bring with me during my winter visit. Their data was stored on a password-coded, secure computer for the duration of the study. Their personal details were kept separate from the data file at all times. All procedures were in accordance with the declaration of Helsinki. The study was approved by the Psychology Research Ethics Committee under reference number 216-1415/1 on June 6, 2015.

2.8 Statistical Considerations

In order to address the issue of small polar sample sizes outlined by Lugg (1991, p. 38), special care is required with statistical considerations (see Temp, Lee & Bak, 2017). In the past, square-root transformations have been applied to non-normally distributed data to allow for parametric analyses (Palinkas, Cravalho, et al., 1995; Palinkas, Houseal, et al., 2000; Palinkas, Johnson, & Boster, 2004; Palinkas et al., 2001; Xu et al., 2003). Additionally, in many cases ordinal questionnaire data was subjected to unsuitable parametric models such as analyses of variance (ANOVA) or Pearson's rho correlation without the necessary adjustments or corrections (see Palinkas, Glogower, et al., 2004; Palinkas, Gunderson, Holland, Miller, &

Johnson, 2000; Palinkas et al., 1996; Palinkas, Johnson, & Boster, 2004; Palinkas et al., 2001; Palinkas, Suedfeld, et al., 1995; Sandal, 2000). These classical ("frequentist") statistical tools of null hypothesis significance testing (NHST) will allow me to reject the null hypotheses (H_0) that there are no differences over time in isolation and no differences between my groups. However, rejecting the null hypotheses does not automatically provide an explanation of what affects the groups or across time. Traditionally, when H_0 is rejected, researchers accept the alternative hypothesis (H_1) that there is a main effect of their particular IV on the DV (Wetzels, van Ravenzwaaij, & Wagenmakers, 2015). This is what all the studies previously cited in this section have done. However, with classical NHST, this conclusion is questionable because H_1 is not assessed at all in these statistical procedures. This means that H_0 may be rejected because it does not offer an explanation of the data and H_1 may be accepted; but because H_1 itself has not been tested at all, it is impossible to know whether H_1 offers a better explanation of the data than H_0. It is possible that neither is a good fit for the observed data (Jarosz & Wiley, 2014). One measure that provides insight into how good a fit my hypotheses are, is the *Vovk-Sellke maximum p-ratio (VS-MPR)*. This ratio informs me of how much more likely my p-values would have been under the best possible alternative hypothesis compared to the null hypothesis. This will be reported alongside the classical linear models.

To strengthen my claim on any observed effects, I added Bayes factor hypothesis testing (BFHT) to my approach. BFHT compares the predictive capacity of H_1 and H_0, enabling me to quantify the evidence that my data provide for both of them (Wagenmakers, Marsman, et al., 2017).This offers conclusions about the predictive performance of either H1 or H0 through the so-called Bayes factor (BF). Because BF are probability ratios, they can be meaningful regardless of sample size which is ideal for my study (Jarosz & Wiley, 2014). The higher this BF is, the greater the support for the respective hypothesis; details of the interpretation can be found in Section 3.2 where they precede the results. Additionally, BFHT can incorporate prior information about the data (Wagenmakers, Marsman, et al., 2017). For my BFHT, I employed JASP and R. BFHT requires declarations of how the prior information that was included in the analyses was determined and I settled on non-informative *Jeffreys-Zellner-Siow priors (JZS priors)*. JZS priors will always yield an interesting effect if the sample size is large but this drawback should not affect my study because my sample size is 18 (Morey & Rouder, 2011). JZS priors' tendency to not result in meaningful results in small samples will mean that my BFHT results will be more conservative than they could be.

In polar psychology, all the published papers cited in this thesis have used traditional classical statistics, that is why I opted for a combined approach: classical and Bayesian. While I will report classical confidence intervals for regression coefficients, I have also included Bayesian *credibility intervals*. A 95% confidence interval for a parameter θ is an interval generated by a procedure that in repeated sampling has an 95% probability of containing θ*'s* true value. A 95% credibility interval, however, means that you can be 95%

certain that the true correlation coefficient of the investigated population lies between the specific values (Wagenmakers, Marsman et al., 2017). Here, my statistical decision-making is outlined in chronological order.

In Chapter 3, investigating whether the Explorers' mood, mental health, and cognition changed over Mission Time classically requires a oneway repeated-measures ANOVA. According to Laerd Statistics (2013), its assumptions are that the DV are normally distributed interval or ratio data, that there are two or more measuring points in the IV, that there are no significant outliers and that the variances of the differences between all measuring points must be equal *(sphericity)*.

Firstly the DV's distribution will be assessed with Shapiro-Wilk tests as done by Palinkas, Reedy, Smith et al. (2007). Non-normally distributed data will be subjected to non-parametric Friedman tests followed by group comparisons using Wilcoxon signed rank tests with the effect size r, as described by Field (2009, p. 579-580). Bonferroni corrections were applied to the Wilcoxon signed rank tests. Different non-parametric tools have been used in polar psychology in the past (Palinkas et al., 2010; Palinkas, Reedy, Smith et al., 2007; Palinkas, Reedy, Shepanek et al., 2007). Normally distributed data will be analysed using a parametric repeated-measures ANOVA with a Huynh-Feldt correction. The Huynh-Feldt correction decreases the ANOVA's chance of erroneously finding an effect that is not present at all (*Type I error*) despite my small sample and ordinal DV (Stiger, Kosinski, Barnhart, & Kleinbaum, 1998). This correction is necessary because my questionnaire data is ordinal, which violates the assumption of interval or ratio date. However, because the Huynh-Feldt correction is continuously applied, it is not necessary to assume sphericity; this correction usually serves to correct violated sphericity. For ANOVA effect size, I will report omega squared (ω^2) because it is reliable with small sample sizes (Levine & Hullett, 2002). For ω^2, 0.01 constitutes a small effect size while 0.06 is a medium effect size and 0.14 is a large effect size (Kirk, 1996). Bonferroni-corrected post-hoc tests were used for all ANOVA in JASP. The correlation tool of choice is Kendall's tau which is allows more accurate generalisations (Field, 2009, p. 225).

The mixed models with Group (Explorers vs. Controls) and Season (Summer 1 vs. Equinox vs. Winter vs. Spring vs. Summer 2) are also included in this chapter. They required a different approach because there is no non-parametric option for a mixed model. But Field (2009, p. 413) suggests that ANOVA's F-statistic remains robust with non-normal data provided that group sizes are equal. So, ANOVA will be the only statistical tool applied for inferences. In the case of ordinal DV, the Huynh-Feldt correction will be used in the mixed models. In the case of interval and ratio DV such as the cognitive tests, the Huynh-Feldt correction will only be applied if Mauchly's test for sphericity indicates that this assumption has been violated. The classical ANOVA will be supplemented with BFHT ANOVA so that the models (Group, Season and null) will compete with one another to provide the best explanation for any effects found.

Chapter 4 presents the data from the interviews and does not require any statistical considerations. Chapters 3 to 5 together serve to illuminate the experiences of the Explorers and address the first part of the research question.

Chapter 5, however, addresses a point that is included among the assumptions above (Laerd Statistics, 2013): a statistical outlier. Wood et al. (1999) suggested that no group's averages can reflect the individual members's Antarctic experiences accurately. Individual differences in perception of and coping with stressors are suppressed in exclusively group-based analyses, according to Wood et al. (1999). They described an example: in 1993, one of their participants experienced a "Christmas slump" during which he perceived an increase in group tensions. His individual perception of this increase was so strong that it skewed the whole group's average. However, this spike in the group's average was not present in 1994, when that participant was absent from the traverse (Wood et al., 1999, p. 324).

Over the course of this study, an unexpected outlier appeared: an Explorer – Albert – developed severe psychiatric complications and withdrew from the expedition. Albert's questionnaire assessments suggested that he was much more emotionally affected than his co-workers at the station; so his data were excluded from the group-based analyses of well-being and cognition fluctuations. Crawford, Garthwaite and Porter (2010) propose a case study methodology that is suitable to support this decision and to underline Albert's condition. This methodology is applied in Chapter 5, where Albert's interview data and his quantitative results are combined to offer a thorough insight into his experience. This case study is unprecedented in the polar psychology literature and was thus not among my research questions. Chapters 5 and 6 thus serve to answer the research question "What makes a good winter candidate?".

In Chapter 6, the question whether personality predicts any of the mental health and mood DV during the polar night requires Bayesian and classical linear regression. Here, several models of personality will compete against one another. In line with Wagenmakers (2017b) suggestions to me, I will set JASP to compare all models to the best model to quantify how good the best predictor model is. JASP can also provide a so-called *analysis of effects* which provides support for the inclusion of the individual effects of the models (Wagenmakers, Marsman, et al. 2017). The classical linear regression will be based on the outcomes of this BFHT. Classical linear regression can be used with ordinal data (Norris et al., 2006) but due to my small sample size, it is likely that some of linear regression's assumptions (independence of observations, homoscedasticity, and normally distributed residuals) may be violated. Non-normally distributed residuals suggest that an effect is missing from the model; but the BFHT confirms which effects should be included and general linear models are robust to violations of normal distributions (Schmider, Ziegler, Danay, Beyer, & Bühner, 2010). This means that problems with non-normality should not affect the classical models' interpretability.

3. The Explorers over Mission Time

This chapter deals with the following questions:

1. Do the Explorers' Mental Health and Mood fluctuate over Mission Time? And if so, how?

2. Does the Explorers' cognitive performance fluctuate over Mission Time? If it does, how?

3. Are these changes also present in their Controls?

The JASP files for this chapter can be found in Appendix B under this link: osf.io/n894w .

3.1 Descriptive Statistics

In this chapter, normal distributions only play a role in choosing the correct model for the within-subjects Explorers analyses, so no comments on normality for the Controls will be made (see Section 2.8).

Personality

Table 3.1 shows the personality traits across the Explorers and Controls.

Table 3.1

The Big Five Personality Traits Across Explorers and Controls.

	Explorers	**Controls**	**Total**
Openness to Experience	28.90 (5.63)	35.00 (4.60)	31.44 (6.01)
Conscientiousness	30.60 (6.29)	29.30 (5.33)	30.28 (5.58)
Extraversion	29.90 (3.14)	26.30 (4.24)	23.33 (4.12)
Agreeableness	31.70 (6.34)	34.10 (4.12)	33.44 (5.19)

	Explorers	Controls	Total
Neuroticism	18.10 (7.61)	16.80 (5.22)	17.06 (4.18)

All the Explorers' personality traits were normally distributed. The inferential comparison of these statistics can be found later on in Section 3.2.

Mood

The Explorers' and Controls' average Mood across Mission Time is in Table 3.2. The maximum possible score for each mood facet is also included. The DV in the left-hand column bear two labels in Tables 3.2 and 3.3: in the analyses concerning only the Explorers, the DV is called Mission Time (levels: After Arrival, Equinox, Winter Isolation, Spring, Summer) while in the analyses differentiating the Explorers and Controls this DV is Season (levels: Summer 1, Equinox, Winter, Spring, Summer 2). This different labeling distinguishes that the within-subjects comparison of the Explorers focuses on their Mission Time passing; the comparison of the Controls and Explorers focuses on Season because the Controls were not deployed on a mission.

Table 3.2

The Mood of the Explorers and their Controls Over Time.

POMS DV	Explorers	Controls	Total	min.	max.
Depression					
After Arrival/Summer 1	2.22 (3.15)	1.11 (1.45)	1.67 (2.45)	0	20
Equinox	1.22 (1.30)**	0.11 (0.33)	0.67 (1.08)		
Winter Isolation/Winter	2.00 (2.35)	1.11 (0.93)	1.56 (1.79)		
Spring	2.33 (2.45)**	1.11 (1.36)	1.72 (2.02)		

POMS DV	Explorers	Controls	Total	min.	max.
Summer/Summer 2	1.55 (2.19)	1.00 (1.00)	1.28 (1.67)		
Tension-Anxiety					
After Arrival/Summer 1	2.44 (3.09)**	2.67 (3.08)	2.56 (2.99)	0	20
Equinox	1.89 (2.20)*	1.44 (1.94)	1.67 (2.03)		
Winter Isolation/Winter	3.00 (2.30)	2.67 (3.00)	2.83 (2.64)		
Spring	2.00 (2.06)	1.33 (1.50)	1.67 (1.78)		
Summer/Summer 2	1.67 (1.58)**	1.67 (2.00)	1.67 (1.75)		
Anger-Hostility					
After Arrival/Summer 1	2.33 (3.08)**	2.44 (3.36)	2.39 (3.13)	0	20
Equinox	2.11 (2.37)	1.22 (2.59)	1.67 (2.45)		
Winter Isolation/Winter	2.44 (2.19)***	1.89 (2.97)	2.17 (2.55)		
Spring	3.44 (3.09)	1.67 (3.28)	2.56 (3.22)		
Summer/Summer 2	2.22 (1.99)	0.44 (0.73)	1.33 (1.72)		
Fatigue					
After Arrival/Summer 1	5.33 (4.27)	3.11 (3.37)	4.22 (3.90)	0	20
Equinox	5.00 (4.80)	4.00 (3.24)	4.50 (4.00)		
Winter Isolation/Winter	4.33 (3.24)	3.55 (2.07)	3.94 (2.67)		
Spring	6.22 (4.82)	3.22 (2.44)	4.72 (4.1)		
Summer/Summer 2	3.44 (2.87)	3.11 (1.83)	3.28 (2.35)		
Confusion					
After Arrival/Summer 1	7.00 (2.65)**	3.67 (1.73)	5.33 (2.77)	0	20
Equinox	3.00 (2.12)	3.11 (1.83)	3.06 (1.92)		
Winter Isolation/Winter	4.22 (1.56)	3.33 (1.12)	3.78 (1.40)		
Spring	3.78 (2.011)	3.00 (1.50)	3.39 (1.82)		
Summer/Summer 2	2.89 (2.32)	2.78 (1.99)	2.83 (2.09)		
Vigor					

POMS DV	Explorers	Controls	Total	min.	max.
After Arrival/Summer 1	10.44 (5.53)	8.56 (6.17)	9.50 (5.76)	0	20
Equinox	10.22 (6.08)	6.00 (4.64)	8.11 (5.68)		
Winter Isolation/Winter	8.67 (1.87)	8.89 (4.73)	8.78 (3.49)		
Spring	6.56 (4.45)	8.89 (5.25)	7.72 (4.87)		
Summer/Summer 2	6.56 (4.16)	7.56 (3.28)	7.06 (3.67)		
TMD					
After Arrival/Summer 1	8.89 (15.65)	4.44 (10.54)	6.67 (13.14)	-16	100
Equinox	3.00 (9.97)	3.67 (5.52)	3.33 (7.83)		
Winter Isolation/Winter	7.50 (10.99)	4.33 (6.36)	5.82 (8.71)		
Spring	11.22 (13.45)	1.44 (6.31)	6.33 (11.37)		
Summer/Summer 2	5.22 (9.86)	1.67 (6.26)	3.44 (8.22)		

Table 3.2 suggests that with regard to the Explorers, four out of five levels of the POMS subscale Depression were non-normally distributed according to the Shapiro-Wilk tests: After Arrival ($W=.72$, $p=.002$), Winter Isolation ($W=.64$, $p<.001$), Spring ($W=.83$, $p=.049$) and Before Departure ($W=.70$, $p=.001$). Subsequently, Depression was subjected to Friedman's test, followed by Wilcoxon signed-rank tests and BFHT. Other non-normally distributed levels included Tension-Anxiety After Arrival ($W=.73$, $p=.003$) and at Equinox ($W=.82$, $p=.034$), Anger-Hostility After Arrival ($W=.71$, $p=.002$) and during Winter Isolation ($W=.66$, $p=.001$), Fatigue at Equinox ($W=0.82$, $p=.037$), and Confusion during Winter Isolation ($W=.73$, $p=.003$). Since these made up for a minority of levels in each DV, all POMS DV other than Depression were subjected to Huynh-Feldt corrected ANOVA and BFHT. Where group comparisons were facilitated in Section 3.2.1, Levene's test of equal

variances was used to test the assumption that there is equal variance among the groups. This assumption was met for all analyses.

Mental Health

Table 3.3 underneath shows the Explorers' descriptive results for the SCL-90-R in comparison to the maximum possible score for each DV. Table 3.3's labeling follows that of Table 3.2. The lowest possible score for each DV was zero but the maxima varied.

Table 3.3

The Mental Health of the Explorers and Controls Over Time.

SCL-90-R DV	**Explorers**	**Controls**	**Total**	**max.**
Somatization				48
After Arrival/Summer 1	1.89 (2.15)*	4.44 (6.12)	3.17 (4.95)	
Equinox	3.44 (3.32)	2.56 (4.85)	3.00 (4.06)	
Winter Isolation/Winter	3.56 (3.17)	5.22 (5.49)	4.39 (4.43	
Spring	4.22 (4.27)	1.67 (2.18)	2.94 (3.54)	
Summer/Summer 2	4.33 (5.34)**	2.89 (2.80)	3.61 (4.20)	
Obsessive Compulsion				40
After Arrival/Summer 1	1.67 (2.06)*	3.89 (4.04)	2.78 (3.32)	
Equinox	4.44 (5.43)	2.22 (2.11)	3.33 (4.16)	
Winter Isolation/Winter	4.33 (3.81)	4.56 (5.25)	4.44 (4.45)	
Spring	4.89 (5.71)	3.00 (2.45)	3.94 (4.37)	
Summer/Summer 2	3.78 (5.17)**	4.33 (4.50)	4.06 (4.71)	
Interpersonal Sensitivity				36
After Arrival/Summer 1	1.00 (1.22)**	2.33 (2.00)	1.67 (1.75)	

SCL-90-R DV	Explorers	Controls	Total	max.
Equinox	2.67 (4.03)**	1.33 (1.32)	2.00 (2.99)	
Winter Isolation/Winter	3.22 (4.74)***	2.33 (4.18)	2.78 (4.36)	
Spring	3.56 (4.77)*	2.11 (3.22)	2.83 (4.02)	
Summer/Summer 2	3.33 (5.48)**	1.67 (2.29)	2.50 (4.16)	
Depression				52
After Arrival/Summer 1	2.33 (1.87)	3.67 (3.64)	3.00 (2.89)	
Equinox	4.89 (4.76)**	2.56 (1.74)	3.72 (3.68)	
Winter Isolation/Winter	3.89 (4.51)**	5.11 (4.23)	4.50 (4.30)	
Spring	7.33 (6.40)	3.22 (3.27)	5.28 (5.37)	
Summer/Summer 2	6.67 (8.27)**	4.22 (3.03)	5.44 (6.18)	
Anxiety				40
After Arrival/Summer 1	1.22 (1.39)**	1.67 (2.35)	1.44 (1.88)	
Equinox	1.56 (2.74)**	1.22 (1.30)	1.39 (2.09)	
Winter Isolation/Winter	2.11 (2.89)**	2.56 (3.09)	2.33 (2.91)	
Spring	1.89 (1.90)	1.22 (1.20)	1.56 (1.58)	
Summer/Summer 2	3.00 (5.48)***	1.33 (2.00)	2.17 (4.09)	
Hostility				24
After Arrival/Summer 1	0.22 (0.67)***	1.00 (1.12)	0.61 (0.98)	
Equinox	1.22 (1.48)	1.00 (1.00)	1.11 (1.23)	
Winter Isolation/Winter	1.11 (1.62)**	1.67 (1.41)	1.39 (1.50)	
Spring	2.22 (2.49)*	1.11 (1.36)	1.67 (2.03)	
Summer/Summer 2	2.11 (2.26)	0.78 (0.67)	1.44 (1.76)	
Phobic Anxiety				28
After Arrival/Summer 1	0.11 (0.33)***	0.11 (0.33)	0.11 (0.32)	
Equinox	0.78 (1.30)***	0.11 (0.33)	0.44 (0.98)	
Winter Isolation/Winter	0.78 (1.99)***	0.44 (1.33)	0.61 (1.65)	

SCL-90-R DV	Explorers	Controls	Total	max.
Spring	0.56 (1.33)***	0.22 (0.44)	0.39 (0.98)	
Summer/Summer 2	0.67 (2.00)***	0.11 (0.33)	0.39 (1.42)	
Paranoid Ideation				24
After Arrival/Summer 1	1.00 (1.41)*	1.11 (1.69)	1.06 (1.51)	
Equinox	2.00 (3.16)**	0.56 (0.88)	1.28 (2.37)	
Winter Isolation/Winter	1.56 (2.65)**	0.67 (1.00)	1.11 (2.00)	
Spring	3.33 (3.74)	1.11 (2.26)***	2.22 (3.21)	
Summer/Summer 2	1.78 (3.60)***	0.44 (1.01)***	1.11 (2.65)	
Psychoticism				40
After Arrival/Summer 1	0.33 (1.00)***	0.78 (1.39)	0.56 (1.20)	
Equinox	2.00 (2.40)	0.44 (0.73)	1.22 (1.90)	
Winter Isolation/Winter	1.33 (2.96)***	0.89 (1.27)	1.11 (2.22)	
Spring	2.00 (2.83)**	0.22 (0.67)	1.11 (2.19)	
Summer/Summer 2	1.44 (2.92)***	0.44 (0.52)	0.944 (2.10)	
Global Severity Index (GSI)				4
After Arrival/Summer 1	0.14 (0.09)	0.23 (0.26)	0.18 (0.20)	
Equinox	0.29 (0.27)	0.18 (0.12)	0.24 (0.21)	
Winter Isolation/Winter	0.29 (0.30)**	0.30 (0.25)	0.29 (0.27)	
Spring	0.38 (0.34)	0.18 (0.13)	0.28 (0.27)	
Summer/Summer 2	0.34 (0.46)**	0.21 (0.14)	0.28 (0.34)	
Positive Symptom Total (PST)				90
After Arrival/Summer 1	25.67 (9.11)	26.67 (15.02)	26.17 (12.06)	
Equinox	19.33 (16.57)	12.78 (7.97)	16.06 (13.05)	
Winter Isolation/Winter	19.89 (19.41)**	17.67 (13.22)	18.78 (16.15)	
Spring	23.11 (17.99)	12.78 (8.84)	17.94 (14.74)	
Summer/Summer 2	22.44 (23.13)	13.67 (7.18)	18.06 (17.22)	

SCL-90-R DV	Explorers	Controls	Total	max.
Positive Symptom Distress Index (PSDI)				4
After Arrival/Summer 1	0.47 (0.19)*	0.61 (0.40)	0.54 (0.31)	
Equinox	1.22 (0.24)*	1.14 (0.50)	1.18 (0.38)	
Winter Isolation/Winter	1.31 (0.33)	1.39 (0.60)	1.35 (0.48)	
Spring	1.39 (0.24)**	1.07 (0.50)	1.22 (0.41)	
Summer/Summer 2	1.33 (0.73)	1.28 (0.76)	1.30 (0.72)	

Shapiro-Wilk's W: *p<.05 **p<.01 ***p<.001

Among the Explorers' non-normally distributed DV were Somatization After Arrival (W=0.80, p=.027) and Before Departure (W=0.78, p=.004) and all levels of Obsessive Compulsion: After Arrival (W=0.82), Equinox (W=0.80), Winter Isolation (W=0.82), Spring (W=0.77) and Before Departure (W=0.72). It was the same for Interpersonal Sensitivity's After Arrival (W=0.77), Equinox (W=0.74), Winter Isolation (W=0.70), Spring (W=0.75) and Before Departure (W=0.67). For Depression, Equinox (W=0.79), Winter Isolation (W=0.74) and Before Departure (W=0.63) were non-normally distributed. Four levels of Anxiety were non-normally distributed: After Arrival (W=0.76), Equinox (W=0.66), Winter Isolation (W=0.74) and Before Departure (W=0.60). Hostility also featured four levels which were non-normally distributed: After Arrival (W=0.39), Equinox (W=0.83), Winter Isolation (W=0.72) and Spring (W=0.80). All of Phobic Anxiety's levels were highly abnormally distributed: After Arrival (W=0.39), Equinox (W=0.65), Winter Isolation (W=0.47), Spring (W=0.50) and Before Departure (W=0.39). After Arrival (W=0.76), Equinox (W=0.65), Winter Isolation (W=0.68), Spring (W=0.79) and Before Departure

(W=0.58) of Paranoid Ideation were also non-normally distributed. Psychoticism's After Arrival (W=0.39), Equinox (W=0.81), Winter Isolation (W=0.54), Spring (W=0.71) and Before Departure (W=0.57) were also non-normally distributed. Of the global indices, PSI's Winter Isolation (W=0.77, p=.017) and Before Departure (W=0.77, p=.013), PDSI's After Arrival (W=0.81, p=.036) and Spring (W=0.76, p=.012) and GSI's Winter Isolation (W=0.73, p=.005) and Before Departure (W=0.64, p=.001) measuring points were non-normally distributed. Only Somatization was analysed using a Huynh-Feldt corrected ANOVA. BFHT was applied to all DV from the SCL-90-R. Where group comparisons were facilitated in Section 3.2.1, Levene's test of equal variances was used: there was equal mental health variance among the groups.

Cognition

Table 3.4 shows the Explorers' scores over Mission Time, the Controls over Season and the Controls re-arranged by Testing Time.

Table 3.4

The Cognitive Performance of Explorers and Controls.

Cognitive DV	**Explorers Mission Time**	**Controls Season**	**Controls Testing Time**
Visual Memory & Learning			
FLMT-Total			
Equinox/Testing Time 1	50.33 (15.33)	52.11 (16.03)	48.33 (15.47)
Winter/Testing Time 2	61.50 (8.30)	55.39 (14.09)	55.44 (15.06)
Summer/Testing Time 3	60.17 (10.14)	47.94 (15.22)	51.17 (15.56)

Cognitive DV	Explorers Mission Time	Controls Season	Controls Testing Time
FLMT-Short Delay			
Equinox/Testing Time 1	11.94 (3.15)	12.11 (4.14)	11.89 (3.55)
Winter/Testing Time 2	13.89 (2.09)***	12.56 (3.36)	12.22 (3.73)
Summer/Testing Time 3	13.67 (1.73)**	11.78 (3.73)	12.11 (3.95)
FLMT-Long Delay			
Equinox/Testing Time 1	11.94 (3.52)*	11.89 (3.55)	11.44 (3.62)
Winter/Testing Time 2	14.00 (2.00)***	12.78 (3.49)	12.33 (2.91)
Summer/Testing Time 3	13.89 (1.45)**	11.67 (2.29)	12.56 (3.75)
FLMT-Interference			
Equinox/Testing Time 1	8.22 (3.07)	6.73 (3.07)	6.33 (3.51)
Winter/Testing Time 2	9.00 (2.80)*	8.72 (2.77)	6.56 (2.84)
Summer/Testing Time 3	8.17 (4.55)	6.17 (3.39)	8.44 (2.88)
FLMT-Confabulations			
Equinox/Testing Time 1	3.33 (3.74)*	3.00 (2.12)	3.60 (1.90)
Winter/Testing Time 2	3.00 (4.30)*	1.67 (1.87)	2.00 (2.49)
Summer/Testing Time 3	2.44 (2.40)	3.56 (2.40)	1.20 (1.81)
FLMT-Rotations			
Equinox/Testing Time 1	4.11 (4.05)	4.11 (4.37)	3.00 (2.29)
Winter/Testing Time 2	1.00 (1.32)*	2.56 (3.17)	4.22 (4.29)
Summer/Testing Time 3	2.89 (4.20)**	3.11 (2.21)	2.56 (3.17)
FLMT-Perseverations			
Equinox/Testing Time 1	4.89 (5.06)	1.89 (2.71)	2.78 (3.90)
Winter/Testing Time 2	0.67 (1.67)***	1.00 (2.00)	2.00 (2.65)
Summer/Testing Time 3	1.22 (2.80)***	2.89 (3.82)	1.00 (2.00)
FLMT-Recognition			
Equinox/Testing Time 1	14.00 (1.41)**	14.11 (1.54)	14.00 (1.50)
Winter/Testing Time 2	14.33 (1.12)***	14.78 (0.67)	14.11 (1.54)
Summer/Testing Time 3	14.67 (0.71)***	14.00 (1.50)	14.78 (0.67)

Cognitive DV	Explorers Mission Time	Controls Season	Controls Testing Time
FLMT-FP Recognition			
Equinox/Testing Time 1	0.67 (0.86)	1.00 (1.58)	0.89 (1.27)
Winter/Testing Time 2	0.56 (1.01)	0.33 (1.00)	1.00 (1.58)
Summer/Testing Time 3	0.33 (0.71)	0.89 (1.27)	0.33 (1.00)
FLMT-Distortions			
Equinox/Testing Time 1	1.00 (2.00)	0.00 (0.00)	0.11 (0.33)
Winter/Testing Time 2	0.67 (1.00)	0.22 (0.44)	0.00 (0.00)
Summer/Testing Time 3	0.22 (0.44)	0.00 (0.00)	0.11 (0.33)
Logical Reasoning (SPM)			
Reasoning Speed			
Equinox/Testing Time 1	48.22 (5.17)	50.00 (12.48)	47.56 (5.55)
Winter/Testing Time 2	46.22 (6.78)	50.22 (4.89)	47.78 (7.60)
Summer/Testing Time 3	49.33 (7.19)	47.33 (4.95)	52.22 (10.29)
Reasoning Accuracy			
Equinox/Testing Time 1	89.4 (7.75)	90.05 (6.19)	86.72 (9.88)
Winter/Testing Time 2	94.72 (4.37)	88.48 (6.44)	89.59 (6.05)
Summer/Testing Time 3	93.49 (4.28)	88.18 (10.58)	87.27 (7.83)
Reasoning Failure			
Equinox/Testing Time 1	4.00 (3.04)	5.11 (3.37)	6.00 (5.02)
Winter/Testing Time 2	2.44 (2.07)	5.67 (3.20)	4.89 (3.55)
Summer/Testing Time 3	2.44 (1.51)	5.33 (5.41)	5.22 (3.53)
Reasoning Skip Rate			
Equinox/Testing Time 1	1.00 (1.66)***	1.22 (2.39)	0.40 (0.84)
Winter/Testing Time 2	0.89 (1.05)*	1.22 (1.48)	1.10 (2.28)
Summer/Testing Time 3	0.89 (1.17)*	0.56 (0.88)	0.90 (1.10)
Visual Attention (SART)			
SART Accuracy			
Equinox/Testing Time 1	54.22 (20.01)	80.00 (15.88)	63.11 (16.94)

Cognitive DV	Explorers Mission Time	Controls Season	Controls Testing Time
Winter/Testing Time 2	60.00 (12.96)*	71.56 (17.71)	71.22 (15.44)
Summer/Testing Time 3	46.67 (16.25)	65.33 (19.39)	79.56 (17.71)
SART RT†			
Equinox/Testing Time 1	381.30 (48.16)	432.59 (135.15)	376.22 (82.16)
Winter/Testing Time 2	359.30 (29.75)	408.46 (105.90)	404.71 (102.34)
Summer/Testing Time 3	327.0 (34.90)	400.38 (121.43)	454.73 (149.48)
SART CV			
Equinox/Testing Time 1	0.25 (0.14)***	0.16 (0.06)	0.19 (0.03)
Winter/Testing Time 2	0.19 (0.04)	0.18 (0.06)	0.17 (0.06)
Summer/Testing Time 3	0.21 (0.04)	0.19 (0.03)	0.17 (0.06)
Auditory Attention (TEA)			
Sustained Attention			
Equinox/Testing Time 1	100.00 (0.00)	100.00 (0.00)	100.00 (0.00)
Winter/Testing Time 2	96.82 (6.30)	98.41 (4.76)	100.00 (0.00)
Summer/Testing Time 3	98.89 (3.33)	100.00 (0.00)	98.90
Selective Attention			
Equinox/Testing Time 1	96.67 (7.07)***	91.11 (13.64)	98.89 (3.33)
Winter/Testing Time 2	97.78 (4.41)***	94.44 (10.14)	90.00 (13.29)
Summer/Testing Time 3	97.78 (4.41)***	97.78 (4.41)	94.44 (10.14)
Cognitive Flexibility			
Equinox/Testing Time 1	77.78 (14.81)	85.56 (17.40)	73.33 (21.79)
Winter/Testing Time 2	76.67 (23.45)*	82.22 (17.16)	92.22 (8.33)
Summer/Testing Time 3	80.00 (25.00)	80.00 (20.00)	84.44 (13.33)

Shapiro-Wilk's W: *p<.05 **p<.01 ***p<.001

† The SART RT showed high SD in the Controls but not in the Explorers. These scores were not transformed given that the Explorers were significantly less accurate than the Controls (see Table 3.17 and Figure 3.19). This lack of accuracy

was accompanied by a more homogenous reaction speed in the Explorers while the higher levels of accuracy in the Controls were achieved with a heterogenous reaction speed. This is complemented by the fact that there were no speed-accuracy trade-offs in the Explorers alone, but when the overall Group was considered speed-accuracy trade-offs occurred (see Section 3.2.2, *Marginally Supported Attention and Inhibition Models*). Additionally, the different Seasons were skewed differently across the Groups so no single one transformation would have been acceptable.

Table 3.4 shows that for Recognition, FP-Recognition and Distortions of the FLMT, the Explorers performed at ceiling: they recognised close to 15 items correctly, falsely identified less than one item as correct and produced very few items that were distorted beyond recognition by the researcher. FLMT-Short Delay in Winter Isolation was non-normally distributed ($W=0.63$, $p<.001$) while FLMT-Long Delay was non-normally distributed in Equinox ($W=0.83$, $p=.043$), Winter Isolation ($W=0.60$, $p=3.418e-05$) and Before Departure ($W=0.66$, $p=0.001$). FLMT-Long Delay by Season showed inequal variances in the Levene's test, but these disappeared when the groups were compared by Testing Time. FLMT Interference List was non-normal during Winter Isolation ($W=0.80$, $p=.022$). FLMT Correct Recognitions were non-normally distributed in Equinox ($W=.76$, $p=.008$), Winter Isolation ($W=0.68$, $p=.001$) and Before Departure ($W=.56$, $p=3.587e-05$). FLMT FP-Recognition was non-normally distributed in Equinox ($W=.75$, $p=.005$), Winter Isolation ($W=0.64$, $p<.001$) and Before Departure ($W=0.56$, $p=3.587e-05$). Furthermore, Winter Isolation ($W=0.49$, $p=4.297e-05$) and Before Departure ($W=0.57$, $p=4.177e-05$) of FLMT Perseverations were non-normally distributed and FLMT Rotations was non-normally distributed in Winter Isolation ($W=0.78$, $p=.011$) as well as Before Departure ($W=0.70$, $p=.001$). During Equinox ($W=.80$, $p=.035$) and in Winter Isolation ($W=0.74$, $p=.005$), FLMT Confabulations was non-normally distributed. Consequently, non-parametric Friedman tests were chosen for those DV whose distribution was mostly non-normal: FLMT Long Delay, Correct Recognitions, FP-Recognition, Perseverations, Rotations and Confabulations. Parametric ANOVA with Huynh-Feldt corrections were applied to FLMT Total and Short Delay.

Reasoning Skip Rate was also non-normally distributed at Equinox ($W=0.69$, $p<.001$), during Winter Isolation ($W=0.82$, $p=.039$) and Before Departure ($W=.76$, $p=.011$) and was subjected to a Friedman test. Reasoning Speed, Accuracy and Failure were analysed using ANOVA with Huynh-Feldt corrections.

SART Accuracy was non-normal during Winter Isolation ($W=0.83$, $p=.044$) while SART Omissions were non-normally distributed at Equinox ($W=0.50$, $p=6.995e-06$), during Winter Isolation ($W=0.40$, $p=4.724e-07$) and Before Departure ($W=0.73$, $p=.003$). SART CV was also non-normally distributed at Equinox. ($W=0.60$, $p<.001$). Thus, of the SART DV only SART Omissions was subjected to non-parametric testing; all other DV were analysed with ANOVA and Huynh-Feldt correction.

3.2 Inferential Statistics

For each hypothesis, the NHST are presented first, followed by the BFHT. Using NHST, I will reject the null model before determining the best alternative model using BFHT. Currently, there are no APA style or standard guidelines for reporting BFHT in psychological science. The makers of JASP host an online forum at http://forum.cogsci.nl/index.php?p=/categories/jasp-bayesfactor where any user of JASP can ask questions. Here, Wagenmakers (2017a) confirmed the validity of my analytic approach and, in a second post suggested a reporting strategy for Bayesian ANOVA/regression models (Wagenmakers, 2017b). In line with his suggestions, I have provided an online Appendix B to this thesis where you can download and inspect the JASP files of my analyses, should you wish to do so (Temp, 2018). Here follows a brief explanation of how to read and interpret the tables for Bayesian analyses, the explanation is based on Wagenmakers, Love et al., (2017). Wagenmakers (2017b) suggested to set JASP to the option of "compare to best model" and quantify BF_{01}, which shows how much better than the other models the best model is. The null model which tests the null hypothesis is included, too. See Table 3.5 for an example.

Table 3.5

An Example Bayesian ANOVA/Regression Table from JASP.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Effect 1	0.031	0.315	14.28	1.00	
Effect 1 + Effect 2	0.031	0.200	7.57	1.61	0.005
Null model	0.031	9.085E-04	0.03	347.15	0.005

Table 3.5 shows three competing models: Effect 1, Effect 1 + Effect 2, and the null model. P(M) is the *prior distribution ("prior")* assumed by JASP based on a JZS prior (refer back to Section 2.8). P(M|data) is the *posterior distribution ("posterior")* which is the prior updated with the information from the analysed data. BFM indicates how much the data have changed the prior model odds, in the example above this is 14.28 for Effect 1, and 7.57 for Effect 1 + Effect 2. BF_{01} shows that Effect 1 explains the data 1.61 times better than Effect 1 + Effect 2, which means that it is only slightly better. However, Effect 1 explains the data 347.15 times better than the null model. Effect 2 is not shown as on its own it was not strong enough. This type of table will be reported whenever there are several competing effect models. When several effect models compete, JASP also offers an "analysis of effects" which suggests which of the effects should be included to produce the best model. See an example below.

Table 3.6

An Example Bayesian Analysis of Effects from JASP.

Effects	P(incl)	P(incl|data)	$BF_{Inclusion}$
Effect 1	0.500	0.204	0.255
Effect 2	0.500	0.176	0.213
Effect 3	0.500	0.184	0.226
Effect 4	0.500	0.173	0.209
Effect 5	0.500	0.990	103.416

Table 3.6 lists five different effects, their *prior inclusion probability (P_{incl}), posterior inclusion probability (P(incl|data))*, and the *change from prior to posterior odds ($BF_{inclusion}$)*. In this example, the data very strongly support the

inclusion of Effect 5 ($BF_{inclusion}$=103.42). These tables can be seen in their entirety the online appendix but in the thesis body, only significant effects will be reported for the competing models.

Bayesian t-tests were run where different levels of an IV needed to be compared, as post-hoc tests have not yet been developed (Wagenmakers, Love et al., 2017). Table 3.7 below summarises how ANOVA/regression models and t-tests will be reported throughout my thesis.

Table 3.7

The Aspects of BFHT Reported Throughout This Thesis.

Reported Aspect	Meaning	ANOVA	t-test
P(M)	prior model probability	✓	–
P(MIdata)	posterior model probability	✓	–
BF_M	the change from prior to posterior model odds	✓	–
BF_{10}	BF supporting H1	–	✓
BF_{01}	BF supporting the “best model” in ANOVA/regression	✓	–
%error	size of the error in the integration routine relative to the BF	✓	✓
95%CI[,]	credibility interval	–	✓

In ANOVA/regression models where the best model has been selected to be on top (cf. Table 3.5), BF_{01} indicates the support for this model over the worse models. In t-tests, where no such comparison takes place, BF_{01} indicates support for the null hypothesis and BF_{10} the support for the alternative hypothesis under examination. Credibility intervals are provided for t-tests: they give a possible range for the posterior distribution. This means that there is a 95% chance that the posterior distribution obtained through the analysed data falls within this range.

BF can be visually represented using the *proportion wheel ("pizza plot").* The proportion wheel represents the odds ratio of a BF as a coloured area in a circle. The odds of a BF are first transformed into an interval between 0 and 1, then plotted as the proportion of a circle. The calculation for obtaining this interval is BF/(BF+1). This is then plotted onto a circle, see Figure 3.1 below for a demonstration.

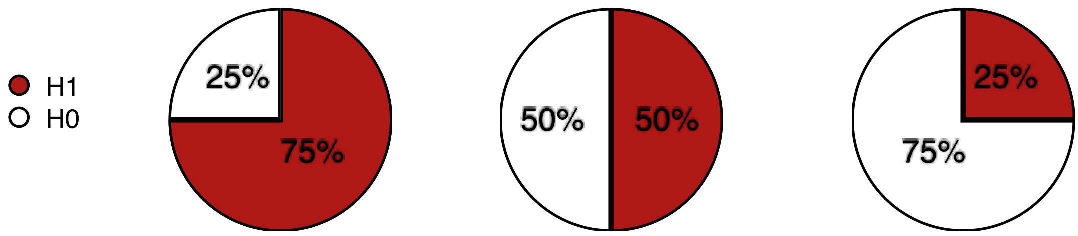

Figure 3.1 How to Interpret a Proportion Wheel.

From left to right, these proportion wheels display a BF_{10}=3 (BF_{01}=1/3), BF_{10}=1 (BF_{01}=1) and BF_{10}=1/3 (BF_{01}=3). The red area in each wheel is the evidence in favour of the alternative hypothesis H_1 (BF_{10}). To calculate the first proportion wheel, the BF_{10} of 3 is divided by BF_{10}+1 (i.e., 4): ¾=0.75. The remaining .25 are the magnitude of the support for the null hypothesis H_0. For an intuitive interpretation of a proportion wheel imagine that the proportion wheel is a dartboard and you throw a dart at it while wearing a blindfold. Once you take off your blindfold, how surprised are you to have hit the smaller of the two areas? In the case of the left and right proportion wheels, you would be somewhat surprised given that the smaller area constitutes only 25%. So your level of surprise would indicate the strength of the support for H_1 in the left proportion wheel and the strength of the support for H_0 in the right proportion wheel. In the middle proportion wheel, there is no conclusive evidence that prefers one hypothesis to the other one and thus you should not be surprised to have hit either area because they are equally sized.

Bar charts, line charts and proportion wheels will be used throughout this chapter to convey the direction of any effects found and their magnitude.

Personality

Two aspects of personality differed between the Explorers and the Controls.

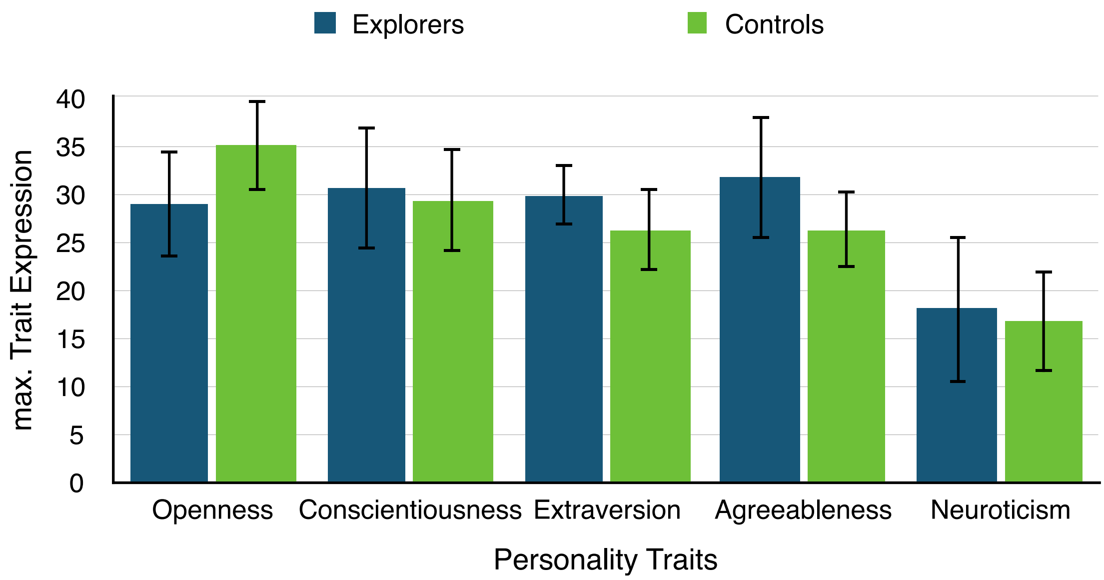

Figure 3.2: The Personality Characteristics of the Explorers and Controls.

The Controls were more Open to Experience than the Explorers ($t=-2.78$, $df=16$, $p=.013$, VS-MPR=6.36, Cohen's $d=-1.31$); this effect was of moderate strength (BF_{10}=4.22, %error=6.240e-6, median=-1.00, 95%CI[-2.09,-0.04]). For Extraversion, Levene's test indicated that variances were unequal ($F_{(1)}$=4.93, p=.041) so Welch's t-test was used: Explorers were more extroverted than Controls (Welch's t-test=2.87, p=.015, VS-MPR=5.99, Cohen's d=1.35). This was also a moderately strong effect (BF_{10}=4.84, %error=8.562e-7, median=-1.03, 95%CI[0.11,2.12]).

An effect size of Cohen's d around 1.3 as presented here suggests that 90% of the Controls scored higher on Openness than the Explorers' average and 90% of the Explorers scored higher on Extraversion than the Controls' average. For both traits, the VS-MPR implies that the obtained p-values are approximately six times more likely under the best alternative hypotheses compared to the null hypotheses. All in all, the Controls described themselves as more open to experiences and the Explorers were more extroverted.

3.2.1: Do the Explorers' Mental Health and Mood Fluctuate over Mission Time? And if so, how?

Within the Explorers' data, the only Mood and Mental Health variables which changed over Mission Time (Well-Being) were POMS-Confusion, POMS-Vigor, SCL-Depression, SCL-Hostility, SCL-Paranoid Ideation and SCL-Psychoticism. A preliminary report on some of these has been published (Temp et al., 2017). Table 3.8 gives an overview over the fluctuations in mood presented here, After Arrival (✯) and Winter Isolation (❄) are symbolically represented throughout.

Table 3.8

Overview of the Effects on Mood.

Time	Confusion		Vigor	
	Explorers (Mission Time)	Both Groups (Season)	Explorers (Mission Time)	Both Groups (Season)
Classical Main Effect	✓	✓	✓	✓
Bayesian Main Effect	✓	✓	✕	✕
After Arrival (✯)	✕	E⬆	✕	✕
Equinox	⬇✯	⬇✯	✕	✕
Winter Isolation (❄)	⬇✯	✕	✕	✕
Spring	✕	✕	✕	✕
Before Departure	⬇✯	⬇❄	✕	✕

Notes: "✕" denotes no changes in comparison to any measurement

"✓" denotes the effect's presence using classical/Bayesian methodology

"⬆" denotes a higher score than the symbolised measurement

"⬇" denotes a lower score than the symbolised measurement

"E" denotes that the Explorers scored differently from the Controls

POMS-Confusion

Mission Time showed a significant main effect on Confusion ($F_{(2.44,19.51)}$=8.61, p=.001, ω^2=.451, VS-MPR=42.77). See Figure 3.3.

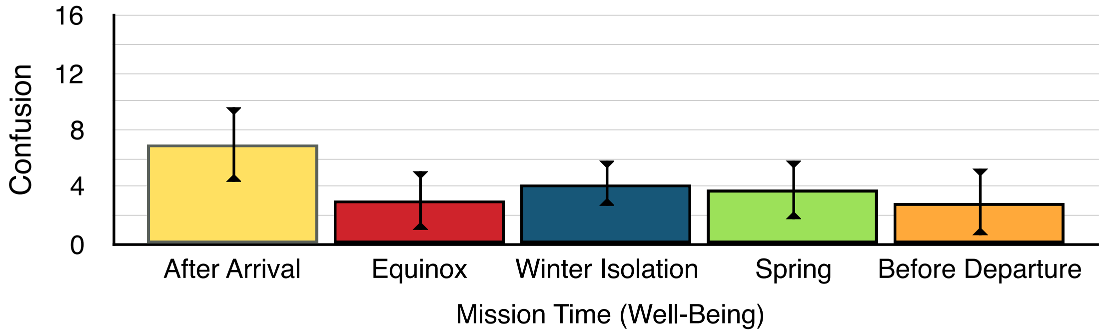

Figure 3.3: Confusion Over the Explorers' Mission Time.

Confusion was highest After Arrival, at 43.75% of the possible maximum. Explorers felt less confused at Equinox (t=4.06, Cohen's d=1.35, p=.036) and Before Departure (t=3.83, Cohen's d=1.28, p=.050) compared to After Arrival, as indicated by Bonferroni post-hoc tests. Additionally, the BFHT provided extreme evidence in support of the effect of Mission Time (Well-Being) on Confusion (BF_{10}=476.36). Bayesian t-tests showed strong evidence for this effect between After Arrival and Equinox (BF_{10}=14.27, 95CI%[0.25,2.10]), Winter Isolation (BF_{10}=10.04, 95%CI[0.23,1.99]), and Before Departure (BF_{10}=11.06, 95%CI[0.21,1.99]), as well as moderate support between Equinox and Winter Isolation (BF_{10}=4.43, 95%CI[-1.65,-0.08]).

When comparing Confusion by Season and between Explorers and Controls, Mauchly's test indicated that the assumption of sphericity had been violated (Mauchly's W=0.302, p=.046) so a Huynh-Feldt correction was applied. There was a significant main effect of Season on Confusion ($F_{(2.90,46.39)}$=7.53, p<.001, ω^2=.24, VS-MPR=122.56), and an interaction effect between Season*Group ($F_{(2.90,46.39)}$=3.60, p=.021, ω^2=.10, VS-MPR=4.49), see Figure 3.4.

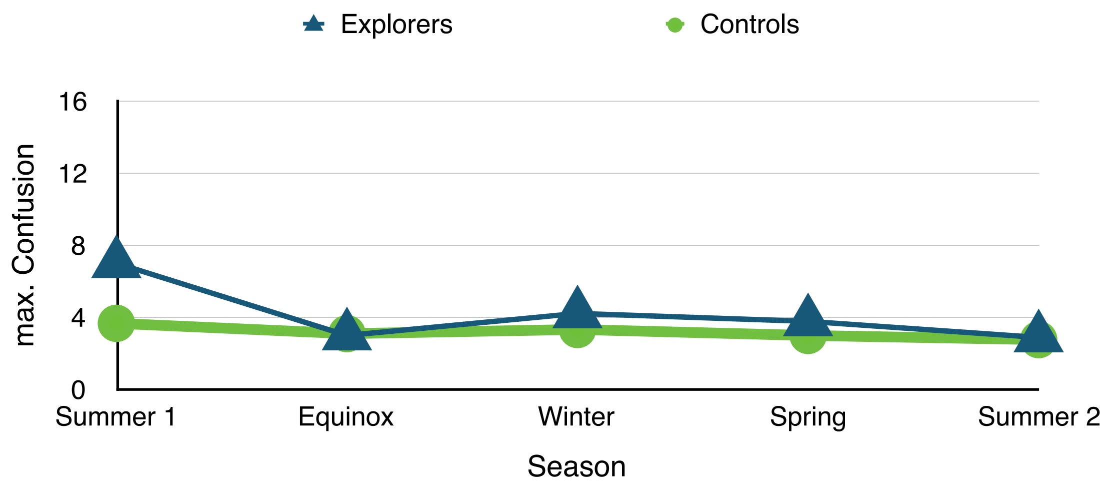

Figure 3.4: The Seasonal Fluctuations of Confusion in Explorers and Controls.

Bonferroni post-hoc tests suggested that Explorers experienced more Confusion in Summer 1 than Summer 2 ($t=3.31$, $p=.041$). These analyses have established that there are effects of Season and Season*Group on Confusion; their VS-MPR suggest that the effect if Season was 123 times more likely under the best alternative hypotheses and Season*Group, 4.5 times more likely.

BFHT determined that Season + Group + Season*Group was the best alternative hypothesis: it explained the present data 861 times better than the null model ($P(M)=0.20$, $P(M|data)=0.71$, $BF_M=9.72$, $BF_{01}=861.09$, error%=1.119). This implies that fluctuations in Confusion are best explained by the effects of Season and Group combined with the interaction effect. Follow-up analyses provided moderate evidence that in Summer 1, Explorers were more confused than Controls ($BF_{10}=7.51$, error%=1.256e-6, CI95%[0.16,2.30]) while seasonal differences occurred between Summer 1 and Equinox ($BF_{10}=8.37$, error%=0.001, CI95%[0.21,1.60]), Winter

(BF_{10}=3.68, error%=0.002, CI95%[0.08,1.44]) and Summer 2 (BF_{10}=11.08, error%=2.095-5, CI95%[0.25,1.65]).

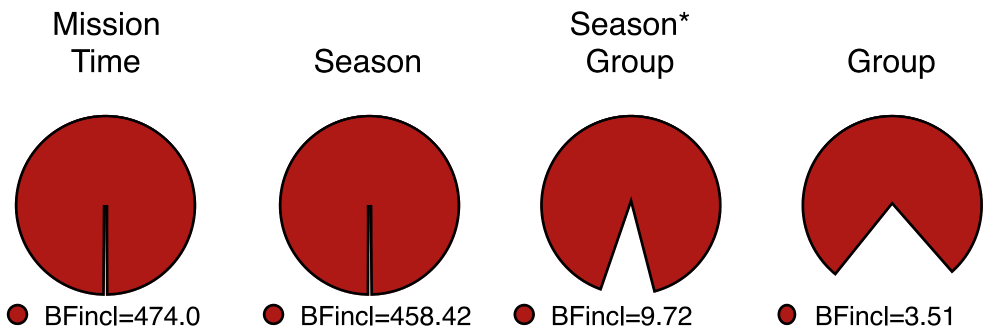

Figure 3.5. The Strengths of the Different Effects on Confusion.

Figure 3.5 conveys that the inclusion of Mission Time's effect was most strongly supported while Group's inclusion only received moderate support. In conclusion, Mission Time had the strongest impact on Confusion, followed by Season. The strong interaction effect Season*Group suggests that the two Groups differed across Seasons. Figure 3.7 underlines this suggestion: the Explorers were more strongly affected by their Mission Time passing than their Controls were affected by Seasons changing.

POMS-Vigor

Mission Time (Well-Being) had a significant main effect on Vigor ($F_{(4,32)}$=2.75, p=.045, ω^2=.159, VS-MPR=2.63). Bonferroni post-hoc tests did not show any specific monthly differences, Figure 3.6 illustrates this.

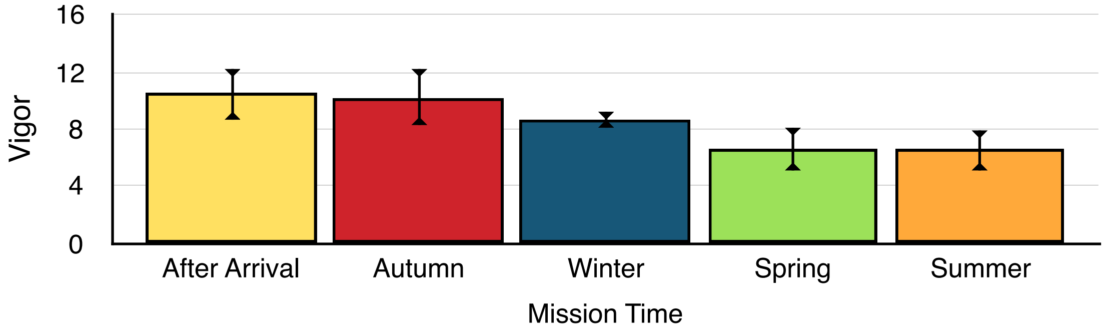

Figure 3.6. The Explorers' Vigor Continuously Declined Over Mission Time.

While the NHST suggests that there is an effect and the null hypothesis should be rejected, the BFHT provided no support for the effect of Mission Time (Well-Being) on Vigor.

When comparing both Groups, the NHST yielded an interaction effect of Season*Group on Vigor; so how vigorous participants felt at any Season depended on the Group they belonged to ($F_{(3.46,55.39)}$=2.83, p=.040, ω^2=.09, VS-MPR=2.88). However, none of the post-hoc procedures revealed any significant differences. Figure 3.8 shows the fluctuations.

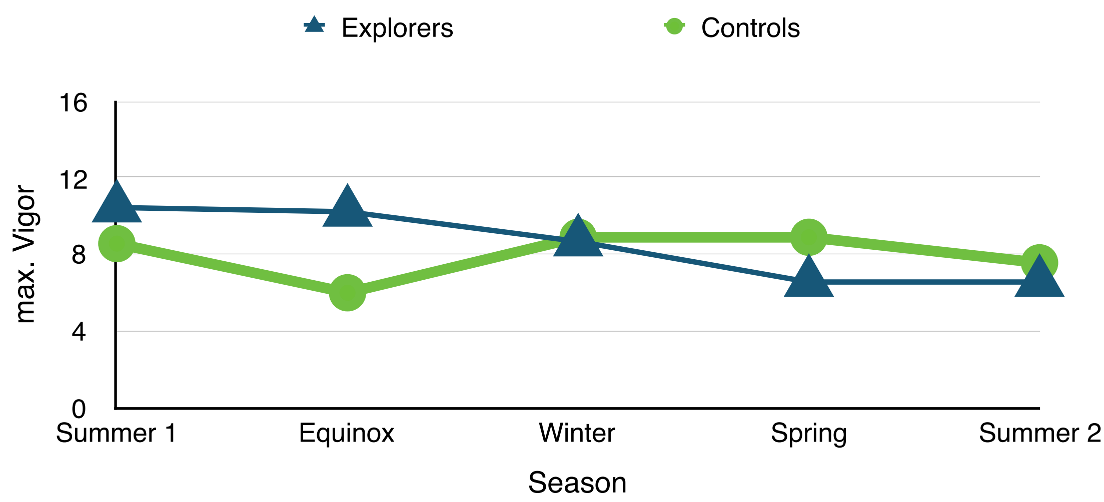

Figure 3.7: Both Groups' Fluctuations in Vigor.

Again, the NHST rejects the null hypothesis but the BFHT does not support the effect of Season or Group. This suggests that while there is an effect on Vigor, this effect is not caused by Mission Time, Season or Group.

The overview of the mental health effects (Table 3.9) includes only one seasonal effect on both Groups: PSDI. All other effects are the Explorers' Mission Time. After Arrival (✯), Equinox (❄) and Winter Isolation (❅) were assigned symbolic representation in this table.

Table 3.9

An Overview of the Effects on Mental Health.

Time	**Depression**	**Hostility**	**Paranoid Ideation**	**Psychoticism**	**PST**	**PSDI ***
Classical Main Effect	✓	✓	✓	✓	✓	✓
Bayesian Main Effect	✓	✓	✕	✕	✓	✓
After Arrival (✯)	✕	✕	✕	✕	✕	⬇✯
Equinox (❄)	⬆✯	⬆✯	✕	⬆✯	⬆✯	⬇✯
Winter Isolation (❅)	✕	✕	✕	✕	✕	⬇✯
Spring	⬆✯	⬆✯	⬆✯❅	⬆✯	✕	⬇✯
Before Departure	⬆✯	⬆✯	✕	✕	✕	⬇✯

Note: *The PSDI effect was only found in both Groups, not in the Explorers alone over Mission Time.

"✕" denotes no changes in comparison to any measurement

"✓" denotes the effect's presence using classical/Bayesian methodology

"⬆" denotes a higher score than the symbolised measurement

"⬇" denotes a lower score than the symbolised measurement

SCL-Depression

The Friedman's test showed a significant main effect of Mission Time (Well-Being) on Depression ($\chi^2_{(4)}$=12.76, p=.012). Explorers reported feeling more depressive at Equinox (M=4.89, SD=4.56, p=.043, r=-.674) and Spring (M=7.33, SD=6.40, p=.020, r=-.773) than After Arrival (M=2.33, SD=1.87). Similarly, Explorers reported higher levels of Depression Before Departure compared to After Arrival (p=.018, r=-.791). If a Bonferroni correction was applied to these Wilcoxon signed-rank tests to account for the heightened risk of a Type I error due to multiple comparisons, the necessary significance level would be p=.005 and none would be significant. Figure 3.09 shows the fluctuations of Depression over Mission Time.

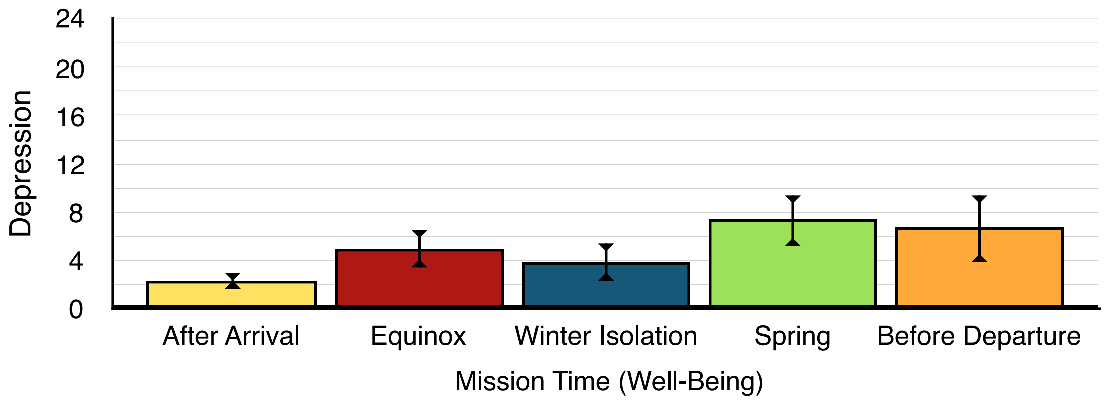

Figure 3.8: The Explorers' Depression Increased over Mission Time.

The BFHT provided moderate support of the overall effect of Mission Time (Well-Being) on Depression (P(M)=0.50, P(M|data)=0.79, BF_{10}=3.83) but did not yield any effects between individual seasons. There were no differences between Groups or Seasons in the NHST nor the BFHT.

In conclusion, Depression was higher at Equinox, in Spring and Before Departure than After Arrival and there was moderate evidence suggesting this was due to Mission Time passing.

SCL-Hostility

Mission Time (Well-Being) had a significant main effect on Hostility ($\chi^2_{(4)}$=12.79, p=.012). Participants felt more hostile at Equinox (M=1.22, SD=1.48, p=.039, r=-.686), in Spring (M=2.22, SD=2.49, p=.033, r=-.711) and Before Departure (M=2.11, SD=2.26, p=.016, r=-.803) compared to After Arrival (M=0.22, SD=0.67).

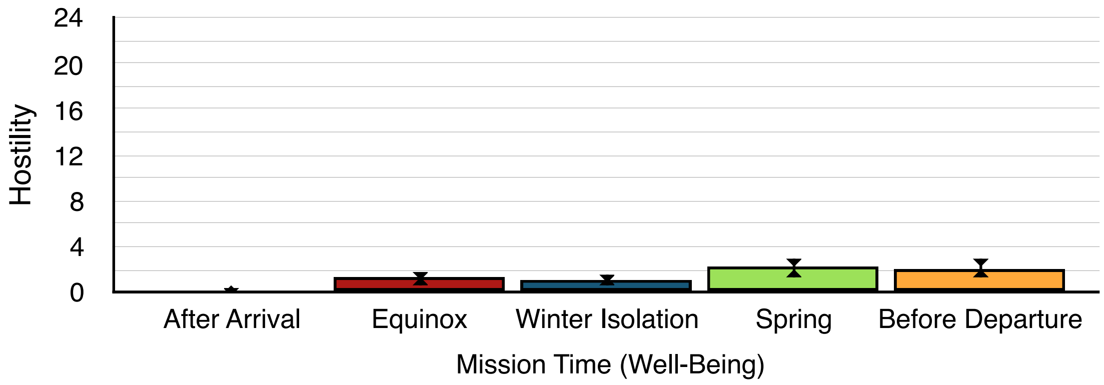

Figure 3.9: The Explorers' Hostility Increased Over Mission Time.

However, when a Bonferroni correction for multiple comparisons was applied to these Wilcoxon signed rank tests (p=.005), none of them remained significant.

The BFHT provided moderate support of the effect of Mission Time (Well-Being) on Hostility (P(M)=0.500, P(M|data)=0.769, BF_M=3.34, BF_{01}=1.00). Additionally, there was moderate support for Mission Time passing being responsible for the Explorers' lower levels of Hostility during the Winter Isolation than Before Departure (BF_{10}=4.17, 95%CI[-1.64,-0.09]). When comparing Groups and Seasons, no changes of Hostility were observed in the NHST nor the BFHT.

This suggests that while Hostility fluctuates according to Mission Time in the Explorers, there are no differences which relate to Season or the Controls.

Marginally Supported Models

In addition to the above, Friedman's test showed a significant main effect of Mission Time (Well-Being) on **Paranoid Ideation** ($\chi^2_{(4)}$=9.97, p=.041). Wilcoxon signed-rank tests revealed that participants reported more Paranoid Ideation in Spring (M=3.33, SD=3.74) compared to After Arrival (M=1.0, SD=1.41, p=.041, r=-.682) and compared to Winter Isolation (M=1.56, SD=2.65, p=.011, r=-.851). If applying Bonferroni's correction to reduce the Type I error risk (p=.005) none of these differences remain significant. However, the BFHT did not provide conclusive evidence in favour of either the alternative or the null hypothesis.

Similarly, Friedman's test provided evidence for an effect of Mission Time (Well-Being) on **Psychoticism** ($\chi^2_{(4)}$=9.90, p=.042). Psychoticism was heightened at Equinox (M=2.0, SD=2.4, p=.042, r=-.678) and in Spring (M=2.0, SD=2.83, p=.026, r=-.738) compared to After Arrival (M=0.33, SD=1.00). Again, using Bonferroni's correction to adjust for multiple comparisons (p=.005) none of the above remained significant. Just as with Paranoid Ideation, the BFHT did not provide conclusive evidence for or against either hypothesis. Neither Paranoid Ideation nor Psychoticism differed by Group or Season in the NHST and BFHT.

SCL-Positive Symptom Total

There was no difference among the Explorers over Mission Time but a main effect of Season on PST when both Groups were considered ($F_{(2.93,46.97)}$=3.41, p=.026, ω^2=.12, VS-MPR=3.89). Bonferroni post-hoc tests suggested that Explorers and Controls reported fewer symptoms at Equinox than in Summer 1 but this only bordered significance (t=3.22, p=.051). The fluctuations can be seen in Figure 3.10.

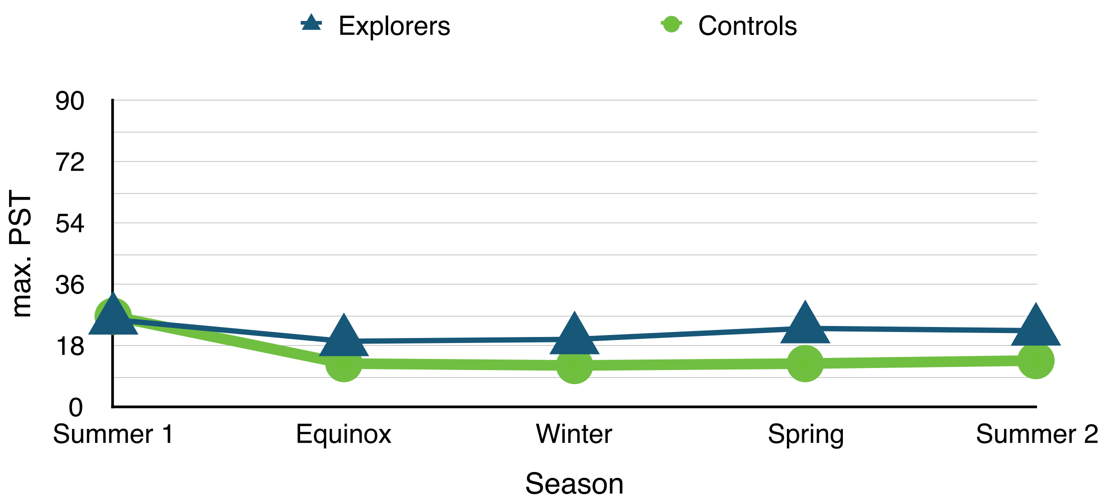

Figure 3.10: The Positive Symptom Total (PST) over Season in both Groups.

The BFHT in Table 3.10 confirmed that the best explanation of these fluctuations was provided by Season, followed closely by Season + Group, and a moderate-to-strong effect between Summer 1 and Equinox (BF10=9.32, error%=0.001, CI95%[0.24,1.63]).

Table 3.10

The Effects of Season and Group on PST.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Season	0.200	0.420	2.90	1.00	
Season + Group	0.200	0.269	1.48	1.60	1.06
Null model	0.200	0.133	0.61	3.16	0.33

Season explained the present data three times better than the null model overall, and between Summer 1 and Equinox in particular it was ten times better. Fewer symptoms were reported at Equinox compared to Summer 1 by both Groups. However, both Groups reported equal amounts of symptoms.

SCL-Positive Symptom Distress Index

There were no fluctuations in the Explorers over Mission Time but over Seasons. Here, Mauchly's test indicated that sphericity had been violated (Mauchly's W=.232, p=.013) so a Huynh-Feldt correction was used. There was a main effect of Season on the PDSI ($F(1.37,21.94)=17.93$, $p<.001$, $\omega 2=.49$, VS-MPR=31538.19). Bonferroni post-hoc tests confirmed that PSDI was higher in Summer 1 than in Equinox ($t=-7.59$, $p<.001$), Winter ($t=-8.54$, $p<.001$), Spring ($t=-8.27$, $p<.001$) or Summer 2 ($t=-5.33$, $p<.001$); see Figure 3.13.

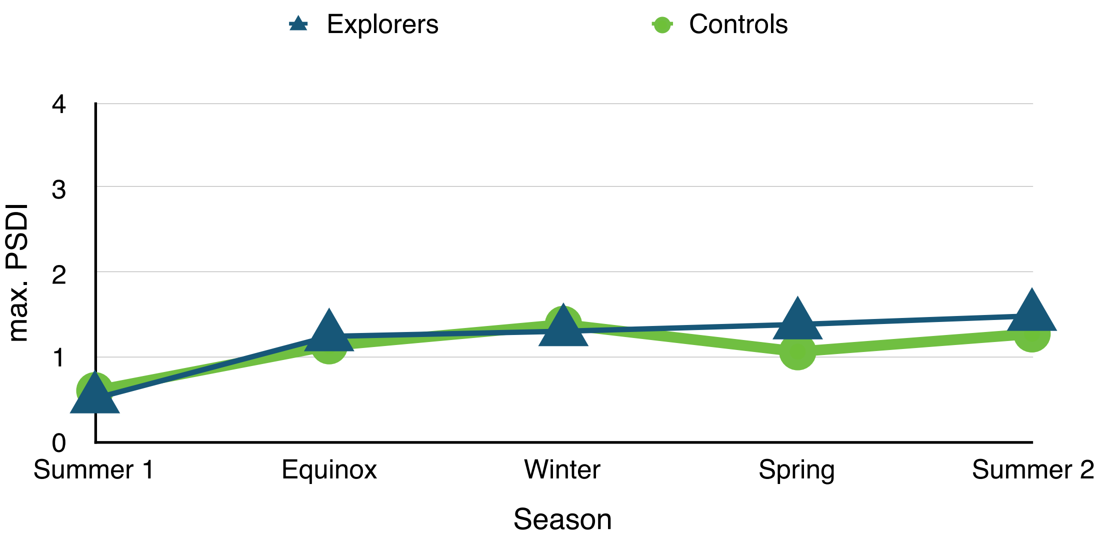

Figure 3.11: The Positive Symptom Distress Index (PDSI) over Season in both Groups.

The amount and intensity of symptoms increases simultaneously in both Groups between Summer 1 to Winter. However, with the onset of Spring the Controls' symptom frequency and intensity begins to decline while the Explorers' continues to increase.

BFHT provided overwhelming support for Season's effect on PDSI (BF_{10}=1.169e+7, %error=0.362). This suggests that the effect of Season explains my data better than the null model by almost twelve million in both Groups as no effect of Group was observed. BFHT paired-samples t-tests supported this effect between all Seasons with the exception of Equinox and Summer 2 as can be seen from Table 3.11 below.

Table 3.11

The Differences in PSDI Across Seasons as Supported by BFHT Paired-Samples T-Tests.

IV 1	IV 2	BF_{10}	error%	Lower 95%CI	Upper 95%CI
Summer 1	Equinox	47393.6	3.276e-9	-3.50	-1.69
	Winter	66184.7	1.059e-9	-3.78	-1.16
	Spring	45235.0	2.274e-9	-3.70	-1.63
	Summer 2	307.6	3.030e-6	-2.34	-0.78

All of the BF_{10} in Table 3.11 are classified as providing "extreme" evidence in favour of the effect of Season on PDSI. However, no pizza plots are presented to demonstrate their magnitude: With BF as high as those for Season's effects on the PSDI in Table 3.11, presenting pizza plots would be inefficient at conveying the effects' magnitudes because the red area in favour of H1 would cover the entire circle. For example, the effect between Summer 1 and Equinox (BF_{10}=47393.6) would cover 99.999789% of the circle which for all purposes amounts to 100% when rounded.

All in all, Season explained 49% of the variance in PSDI; this effect would only have a 0.1% chance of occurring under the null hypothesis. Additionally, under the best alternative hypothesis –that there is an effect of Season on PSDI– finding this p-value of $p<.001$ was 31.500 times more likely. My data was approximately twelve million times more likely to occur under the hypothesis that Season does have an effect on PSDI. So, altogether I conclude that participants of both Groups experienced a higher amount of symptoms as well as more pronounced symptoms of mental distress in the colder months.

Consequently, the answer to the question of whether the Polish Arctic Explorers' mood and mental health changed over the course of their mission is that yes, both changed. Over time, the Explorers undergo a decline in confusion which is paralleled by a decrease in vigor. Simultaneously, depression and hostility increase – especially after the winter isolation ends. The Explorers also reported an increase in paranoid ideation at the end of the winter isolation and an increase in psychoticism before and after the winter isolation. It is important to know that with such a low mean in psychoticism these changes do not reflect a psychosis incidence. Rather, Explorers' need to be alone before and after the isolation period is increased compared to during the isolation period. The changes in paranoid ideation and psychoticism seemed to be unrelated to mission time passing and are perhaps more influenced by other factors such as station life events. Examples of such events include arguments and fall outs between individual participants, Christmas celebrations and the evacuations of different people to name a few. Such rare events cannot be included in quantitative measures and need to explored qualitatively.

3.2.2: Does the Explorers' cognitive performance fluctuate over Mission Time? If it does, how?

An overview of the main results – NHST and BFHT – with regard to the IV Mission Time, Season, Testing Time and Group is provided in Table 3.12 below.

Table 3.12

An Overview of the Cognitive Results Between Groups, Over Mission Time, Season, and Testing Time.

Cognitive DV	Equinox	Winter Isolation	Before Departure/ Summer	Classical	Bayesian
FLMT Total					
Explorers (Mission Time)	×	⬆❊	×	✓	✓
Both Groups (Testing Time)	×	⬆❊	⬆❊	✓	✓
FLMT SD					
Explorers (Mission Time)	×	×	⬆❊	✓	✓
Both Groups (Testing Time)	×	⬆❊	×	✓	×
FLMT LD					
Explorers (Mission Time)	×	⬆❊	×	✓	✓
Both Groups (Testing Time)	×	⬆❊	⬆❊	✓	✓
FLMT Perseverations					
Explorers (Mission Time)	×	⬇❊	×	×	✓
SART Accuracy					
Season + Group	E⬇	×	×	✓	✓
Testing Time + Group	×	×	E⬇	✓	✓

Cognitive DV	Equinox	Winter Isolation	Before Departure/ Summer	Classical	Bayesian
SART Reaction Time					
Explorers (Mission Time)	✕	✕	⬇❊	✓	✓

Notes: "✕" denotes no changes in comparison to any measurement

"✓" denotes the effect's presence using classical/Bayesian methodology

"⬆❊" denotes a higher score than the Equinox measurement

"⬇❊" denotes a lower score than the Equinox measurement

"E⬇" denotes that the Explorers scored lower than the Controls at this point

Details on these results ensue.

Visual Learning and Memory

A within-subjects ANOVA with Huynh-Feldt correction yielded a significant main effect of Mission Time on **FLMT-Total** ($F_{(2,16)}$=8.52, p=.003, ω^2=.442, VS-MPR=20.95). Mission Time explained 44% of the variance in FLMT Total, making this a large effect size. Bonferroni-corrected post hoc tests showed significant differences between between Equinox and Winter Isolation (t=-3.49, p=.024) and approached significance between Equinox and Before Departure (t=-2.94, p=.056) but not between Winter Isolation and Before Departure. This suggests that the Explorers correctly recalled more geometric designs during Winter Isolation than they did at Equinox (Figure 3.12).

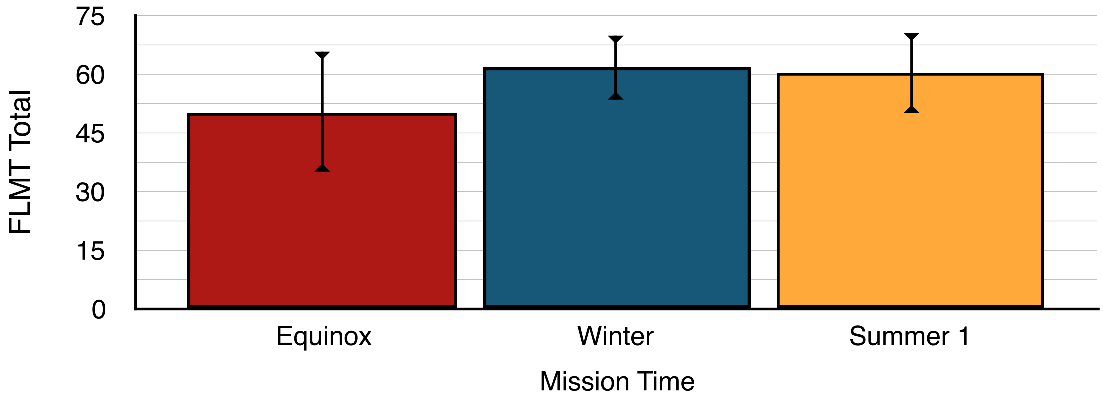

Figure 3.12: FLMT Total increased over Mission Time (error bars show the SD).

The BFHT indicated strong evidence for the impact of Mission Time on FLMT Total (P(M)=0.500, P(M|data)=0.929, BF_M=12.90, BF_{01}=1.00). To check for time differences, Bayesian paired samples t-tests were run. They provided strong support for the influence of Mission Time on FLMT Total during Equinox and Winter Isolation (BF_{10}=7.48, 95%CI[-1.84,-0.17]) and moderate support for this effect between Equinox and Summer (BF_{10}=3.89, 95%CI[-1.62,-0.08]). Figure 3.14 below shows the fluctuations across Mission Time, Season, and Testing Time.

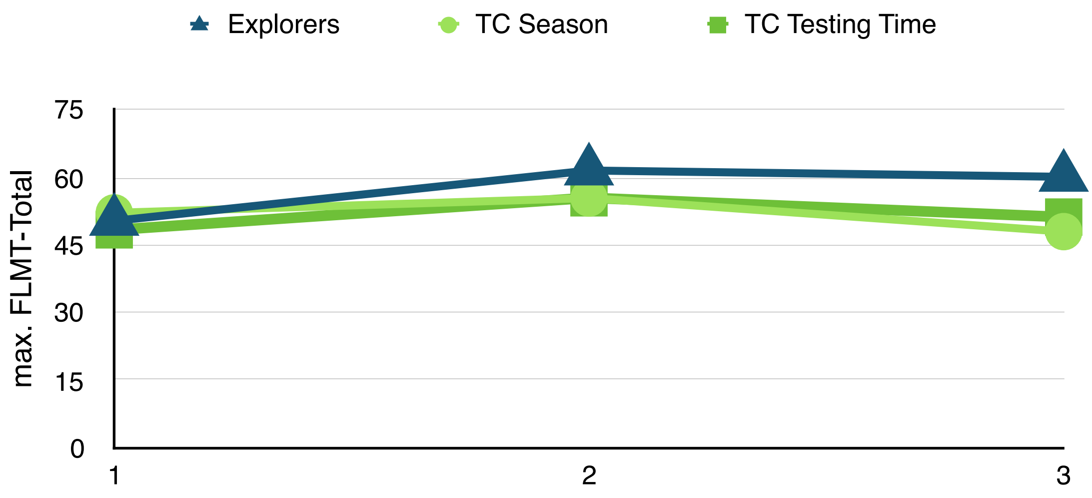

Figure 3.13: The Fluctuations in Learnt Designs Over Mission Time, Testing Time and Season in Both Groups.

In this figure, the x-axis reads “1”, “2” and “3” which represents Testing Times 1, 2, and 3 as well as Equinox (“1”), Winter (“2”) and Summer (“3”). The Explorers’ data did not need re-arranging so they are only represented with a single line. The Controls’ Season performance and Testing Time performance is denoted by separate lines.

When including the Controls, the mixed model ANOVA for FLMT-Total yielded an effect of Season ($F_{(2,32)}$=7.16, p=.003, ω^2=.20, VS-MPR=23.09) and an interaction effect between Season*Group ($F_{(2,32)}$=6.66, p=.004, ω^2=.19, VS-MPR=17.30). Bonferroni post hoc tests substantiated this difference between Equinox and Winter (t=-3.37, p=.011). The BFHT suggested that the best model was Season + Group + Season*Group.

Table 3.13

The Models Predicting FLMT-Total.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Season + Group + Season*Group	0.200	0.780	14.15	1.00	
Null model	0.200	0.108	0.49	36.14	1.638

The evidence in favour of Season + Group + Season*Group was strong (BF_M>10). The analysis of effects provided strong evidence in favour of the inclusion of Season and Season*Group, and moderate evidence for the inclusion of Group (Table 3.14).

Table 3.14

The Analysis of Effects on FLMT-Total.

Effects	P(incl)	P(incl|data)	$BF_{Inclusion}$
Season	0.600	0.964	17.70
Group	0.600	0.870	4.47
Season*Group	0.200	0.780	14.15

The seasonal differences appeared between Equinox and Winter (BF_{10}=12.21, error%=5.876e-6, 95%CI[-1.71, -0.26]).

When the Controls' data was re-arranged to reflect their Testing Time rather than the Season, a significant main effect on FLMT-Total ($F_{(2,32)}$=8.01, p=.002, ω^2=.27, VS-MPR=37.54) emerged, followed by Bonferroni post-hoc procedures between Time 1 and Time 2 (t=-3.50, p=.008) as well as between Time 1 and Time 3 (t=-3.08, p=.020). BFHT provided strong evidence for the effect of Testing Time on FLMT Total.

Table 3.15

Testing Time was the Best Predictor of FLMT-Total.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Testing Time	0.200	0.427	3.57	1.00	
Testing Time + Group	0.200	0.345	2.11	1.37	1.894E-04
Null model	0.200	0.021	0.06	32.65	9.221E-04

Testing Time was not much better than Testing Time + Group but Testing Time alone received moderate support (BFM>3). Testing Time was the only effect whose inclusion was supported (P(incl)=0.600, P(incl|data)=0.965, $BF_{inclusion}$=18.16). Bayesian paired-samples t-tests supported the evidence provided by the Bonferroni procedures: participants performed better at Time 2 (BF_{10}=15.80, error%=9.296e-6, CI95%[-1.75,-0.36]) and Time 3 (BF_{10}=7.28, error%=0.001, CI95%[-1.58,-0.25]) compared to Time 1. Figure 3.16 below shows the magnitudes of the different effects on FLMT-Total.

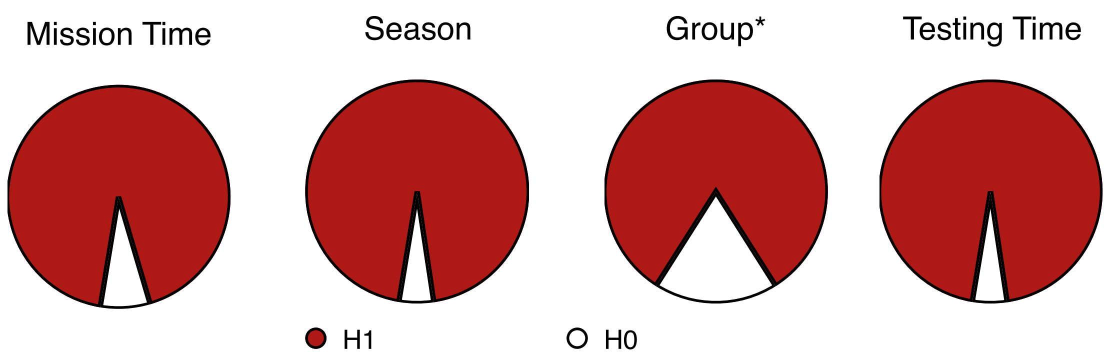

Figure 3.14: The Magnitude of the Effects of Mission Time, Season, Group and Testing Time on FLMT-Total.

Note: *Group is taken from the model featuring Season, this was the strongest possible effect of Group. In the Testing Time model, Group's inclusion was not recommended by the analysis of effects.

Altogether, Testing Time on its own provided the strongest explanation of FLMT Total. When it was included in the model, Group was no longer a meaningful predictor as it had previously been with Season. This suggests that while Season may play a role in visual learning capacity, practice effects did take place under ICE and control conditions.

FLMT-Short Delay

A within-subjects oneway ANOVA with Huynh-Feldt correction yielded a significant main effect of Mission Time on FLMT-SD ($F_{(1.57,12.55)}$=6.33, p=.017, ω2=.359, VS-MPR=5.37). However, Bonferroni post-hoc tests revealed no significant differences between individual seasons (Figure 3.14).

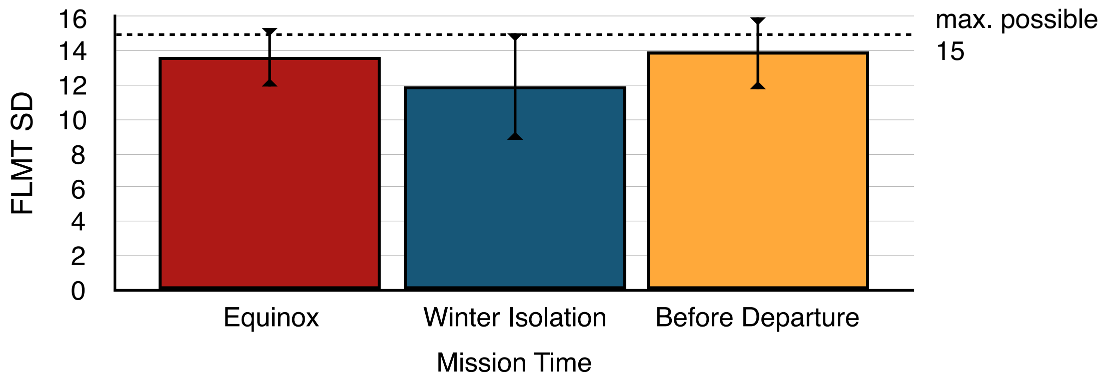

Figure 3.15: The Average Amount of Items Recalled at SD during Equinox, Winter Isolation and Before Departure.

The BFHT confirmed that Mission Time was the best model (P(M)=0.500, P(M|data)=0.843, BF_M=5.38, BF_{01}=1.00) in comparison to the null model (P(M)=0.500, P(M|data)=0.157, BF_M=0.186, BF_{01}=5.38). Bayesian paired sample t-tests showed moderate evidence for this effect between Equinox and Before Departure (BF_{10}=3.04, 95%CI[-1.53,-0.02]).

When comparing both Groups, there was a main effect of Season ($F_{(2,32)}$=4.35, p=.021, ω^2=.14, VS-MPR=4.47) and an interaction effect of Season*Group on FLMT SD ($F_{(2,32)}$=3.41, p=.045, ω^2=.10, VS-MPR=2.62). Bonferroni post-hoc tests suggested that participants recalled more SD items in Winter than in Equinox (t=-2.66, p=.049). There was also a main effect of Testing Time on FLMT SD ($F_{(2,32)}$=4.61, p=.017, ω^2=.15, VS-MPR=5.22) but Bonferroni post-hoc tests did not reveal any specific differences. Neither of these effects was supported by the BFHT.

With regard to FLMT SD, these analyses suggest there is an improvement over the Seasons in both Groups. This improvement is particularly pronounced among the Explorers' Equinox and Before Departure points as well as the overall Groups' Equinox and Winter points. These effects disappeared when Testing Time was examined instead of Season, suggesting that this was not a practice effect.

FLMT-Long Delay

A Friedman test revealed a main effect of Mission Time on FLMT-LD ($\chi^2_{(2)}$=11.08, p=.004). Wilcoxon signed-rank tests showed a significant difference between Winter and Equinox (p=.027, r=-.74). With a Bonferroni correction (p=.017), this Wilcoxon signed-rank test is no longer significant even though Mission Time accounts for 74% of the variance in the shared ranks of FLMT LD (Figure 3.16).

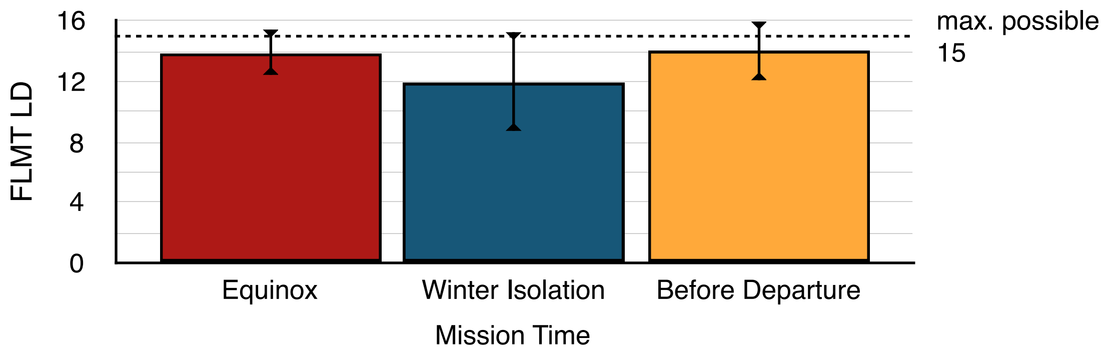

Figure 3.16: Long-delayed Recall is lower during Winter Isolation than at Equinox or Before Departure.

The BFHT yielded that Mission Time (P(M)=0.500, P(M|data)=0.786, BF_M=3.67, BF_{01}=1.00) explained my data 3.68 times better than the null model (P(M)=0.500, P(M|data)=0.214, BF_M=0.273, BF_{01}=3.67, error%=0.479). The ensuing t-tests showed moderate evidence for this effect between Equinox and Winter Isolation (BF10=4.08, 95%CI[-1.63,-0.08]).

When comparing the Groups, there was a main effect of Season ($F_{(1.9,30.55)}$=4.66, p=.018, ω^2=.15, VS-MPR=5.03) on FLMT LD. Bonferroni post-hoc tests revealed that participants remembered more at LD in Winter than in Equinox (t=-2.97, p=.026). There was no support for Season's effect in the BFHT (BFM<3) and neither Season nor Group was recommended for inclusion.

However, there was a main effect of Testing Time on FLMT LD ($F_{(2,32)}$=4.66, p=.005, ω^2=.23, VS-MPR=14.89): participants recalled more items after a half-hour delay at Time 2 (t=-2.96, p=.026) and Time 3 (t=-2.79, p=.038) compared to Time 1. This effect was also supported by the BFHT (Table 3.16).

Table 3.16

Testing Time was the Best Model for FLMT LD.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Testing Time	0.200	0.473	3.61	1.00	
Testing Time + Group	0.200	0.326	1.93	1.45	1.333
Null model	0.200	0.049	0.14	9.81	0.781

There was only moderate support for Testing Time's effect (BFM>3) but this evidence was bordering on strong (BF01=9.75) in comparison to the null model. There was moderate support for an increased performance at Time 2 (BF_{10}=5.87, error%=0.001, CI95%[-1.53,-0.25]) and Time 3 (BF_{10}=4.38, error%=0.002, CI95%[-1.48,-0.11]) compared to Time 1. Testing Time was the only effect whose inclusion was supported (P(incl)=0.600, P(incl\| data)=0.919, $BF_{inclusion}$=7.54). This means that Testing Time's effect on the data was stronger than that of Season, Group, or Mission Time (see Figure 3.17).

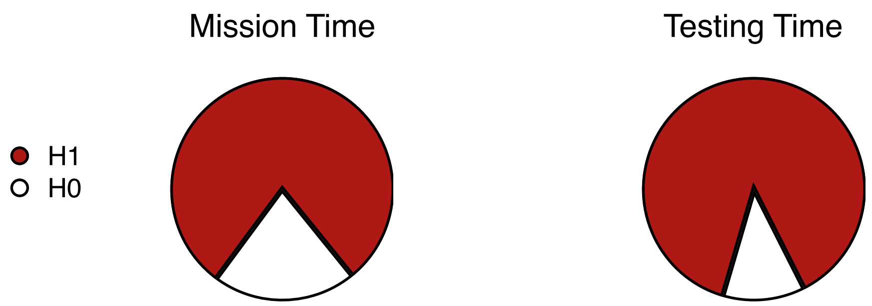

Figure 3.17: The Magnitude of Mission Time's and Testing Time's Effects on FLMT LD.

Altogether, FLMT LD was subject to practice effects, too: both Groups became better each time they took the test, despite the parallel versions.

Mission Time explained 74% of the variance between Equinox and Winter but since the Explorers' Mission Time was congruent with their Testing Time this may well be a practice effect, too.

Marginally Supported Visual Memory Models

A Friedman test suggested a significant difference in **FLMT-Interference** over Mission Time ($\chi^2_{(2)}$=7.82, p=.020). However, the ensuing Wilcoxon signed-rank test did not support this effect between any particular mission points and the BFHT indicated moderate support for the null hypothesis (P(M)=0.500, P(MIdata)=0.786, BF_M=3.67, BF_{01}=1.00). No support for any effect between Groups, Seasons, or Testing Times emerged in the NHST and the BFHT. However, the null hypothesis was not supported either.

The evidence for the effect of Mission Time on **FLMT-Confabulations** presented similarly: a Friedman test yielded a main effect ($\chi^2_{(2)}$=8.31, p=.016) but no seasonal differences were found employing Wilcoxon signed-rank tests. The BFHT indicated moderate support for the null hypothesis (P(M)=0.500, P(MIdata)=0.726, BF_M=3.20, BF_{01}=1.00). I thus accept the null hypothesis that mission time does not affect the number of confabulations my Explorers made over time. However, between Groups, Seasons, or Testing Times there was no support for any effect nor for the null model.

The Friedman test did not provide evidence for the effect of Mission Time on **FLMT-Perseverations**; but the BFHT provided moderate support for this effect (P(M)=0.500, P(M|data)=0.842, BF_M=5.32, BF_{01}=1.00). This was followed up with Bayesian paired samples t-tests which supplied moderate support for an improvement of FLMT Perseverations between Equinox and Winter Isolation (BF_{10}=5.44, 95%CI[-1.74,-0.13]).

In the mixed model, FLMT-Perseverations were affected by Season ($F_{(2,32)}=4.08$, $p=.026$, $\omega^2=.13$, VS-MPR=3.84) and the interaction of Season*Group ($F_{(2,32)}=3.61$, $p=.039$, $\omega^2=.11$, VS-MPR=2.93). Bonferroni post-hoc tests showed that fewer perseverations were made in Winter compared to Equinox ($t=2.83$, $p=.035$), but BFHT provided no support for the alternative or the null hypothesis. No differences emerged where Testing Time was concerned. This suggests that in Winter, fewer perseverations were made.

For **FLMT-Distortions** there was an effect of Group: Explorers produced more Distortions than Controls ($F_{(1,16)}=5.20$, $p=.037$, $\omega^2=.19$, VS-MPR=3.04). This suggests that there was only a 3.7% chance of this effect occurring if the null hypothesis were true. The BFHT actually suggested that the null model was the best one but there was still only anecdotal evidence in favour of it (P(M)=0.200, P(M|data)=0.426, BF_M=2.26, BF_{01}=1.00).

Neither classical NHST nor BFHT provided support for any alternative nor the null hypotheses with regard to the remaining FLMT-related DV.

Furthermore, there were no changes in Logical Reasoning to be reported which suggests that the Explorers' reasoning skills were unaffected by their mission, and that the Explorers performed as could be expected of them according to the Controls' performance.

Attention and Inhibition

There were no differences in **SART Accuracy** over Mission Time in NHST; and BFHT analyses did not provide evidence in favour either hypothesis. No significant fluctuations in SART Accuracy occurred over Mission Time. Figure 3.18 below highlights that the Explorers' SART Accuracy remained at a low level throughout the mission.

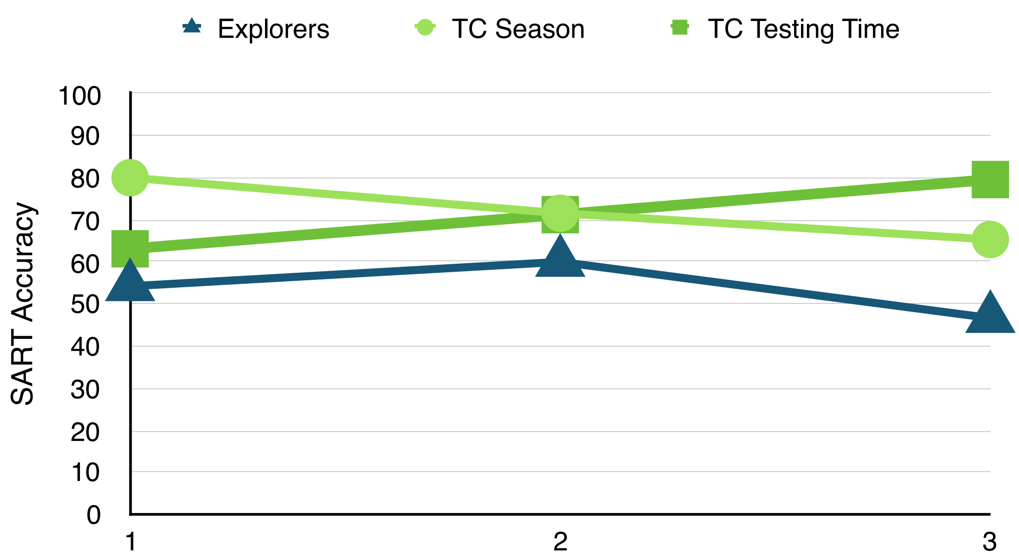

Figure 3.18: The Explorers' SART Accuracy was Continuously Lower than the Controls'.

In Figure 3.18, even the Controls' first Season and Testing Time 1 measurements differ from one another because the Controls started in different seasons (see Section 7.4). In the mixed model, there was a main effect of Season ($F_{(2,32)}$=3.54, p=.041, ω^2=.12, VS-MPR=2.82) and a main effect of Group ($F_{(1,16)}$=9.17, p=.008, ω^2=.31, VS-MPR=9.53) on SART Accuracy. Bonferroni post-hoc tests could not identify which Seasons differed from one another but the Controls consistently outperformed the Explorers (t=-3.03, p=.008). The BFHT provided no conclusive evidence in favour of any effect (all BF_M<3) but the best model in comparison to the null model was Season + Group (Table 3.17).

Table 3.17

The Effects of Season and Group on SART Accuracy.

Model	**P(M)**	**P(M|data)**	BF_M	BF_{01}	**error%**
Season + Group	0.200	0.428	2.99	1.00	
Group	0.200	0.249	1.32	1.72	1.928
Season + Group + Season*Group	0.200	0.210	1.06	2.04	1.867
Null model	0.200	0.043	0.18	9.91	1.138

However, the only main effect whose inclusion was supported was Group (P(incl)=0.500, P(incl|data)=.886, $BF_{inclusion}$=5.19). BFHT independent samples t-tests revealed that this Group difference was strongest during Equinox (BF_{10}=6.11, error%=5.868e-4, 95%CI[-2.23,-0.15]) when Controls responded on 30% more accurately than Explorers.

With regards to Testing Time, there was an interaction effect of Testing Time*Group ($F_{(2,32)}$=4.35, p=.021, ω^2=.15, VS-MPR=4.48) and a main effect of Group ($F_{(1,16)}$=8.90, p=.009, ω^2=.31, VS-MPR=8.84). The post-hoc tests did not show any differences between time points; the Controls were more accurate than the Explorers though (t=-2.89, p=.009). The BFHT suggested that the best model was Testing Time + Group + Testing Time*Group (P(M)=0.200, P(M|data)=0.426, BF_M=2.97, BF_{01}=1.00) but even this model received only anecdotal support (BF_M>3). The analyses of effects showed that in order to predict SART Accuracy, Group was the only effect to be included (P(M)=0.600, P(M|data)=0.905, $BF_{inclusion}$=6.39).

BFHT independent samples t-tests revealed that this Group difference was strongest at Testing Time 3 (BF_{10}=34.47, error%=4.312e-4, 95%CI[-2.80,-0.40]) where Controls responded on 30% more accurately than Explorers, on average. The effects are displayed in order of magnitude from strongest to weakest in Figure 3.19.

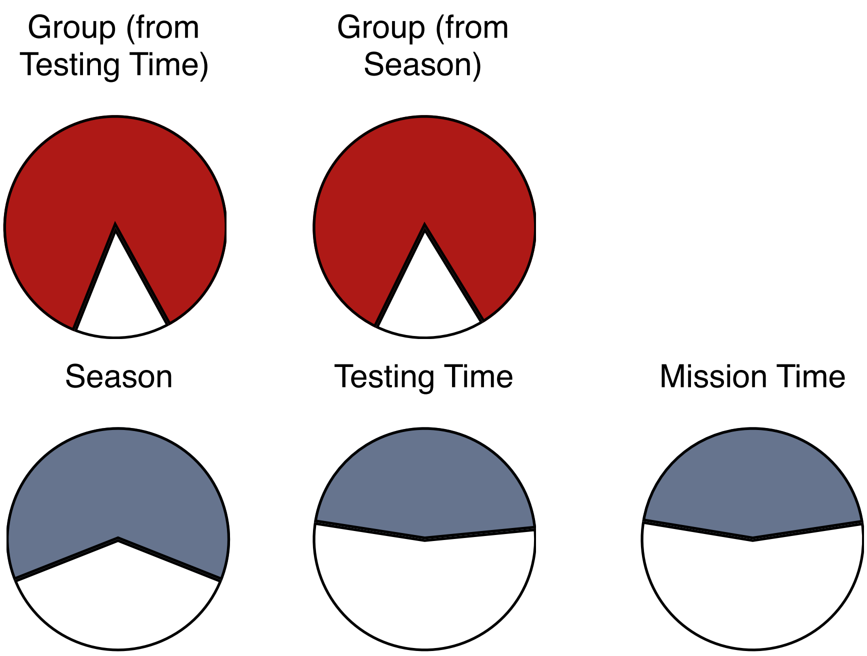

Figure 3.19. The Magnitude of the Effects of Mission Time, Season, Testing Time, and Group on SART Accuracy.

The strongest effect in both mixed models was Group, and Group was slightly stronger in comparison to Testing Time than in comparison to

Season. There were no effects over Mission Time, Season, or Testing Time. This suggests that the Controls had better inhibitory control than the Explorers at the beginning and maintained this over time. When looking at Figure 3.20, it is visible that the Controls showed a trend towards improved inhibition over time while the Explorers did not.

SART RT

With regard to **SART RT,** there was a significant main effect of Mission Time ($F_{(2,16)}$=5.32, p=.017, ω^2=.312, VS-MPR=5.32). A Bonferroni post-hoc test revealed that Explorers were faster at Equinox than Before Departure (t=3.50, p=.024). The BFHT provided moderate support for this effect (P(M)=0.500, P(M|data)=.873, BF_M=6.90, BF_{01}=1.00), while follow-up t-tests showed that it was most pronounced between Equinox and Before Departure (BF_{10}=7.51, 95%CI[0.15,1.85]).

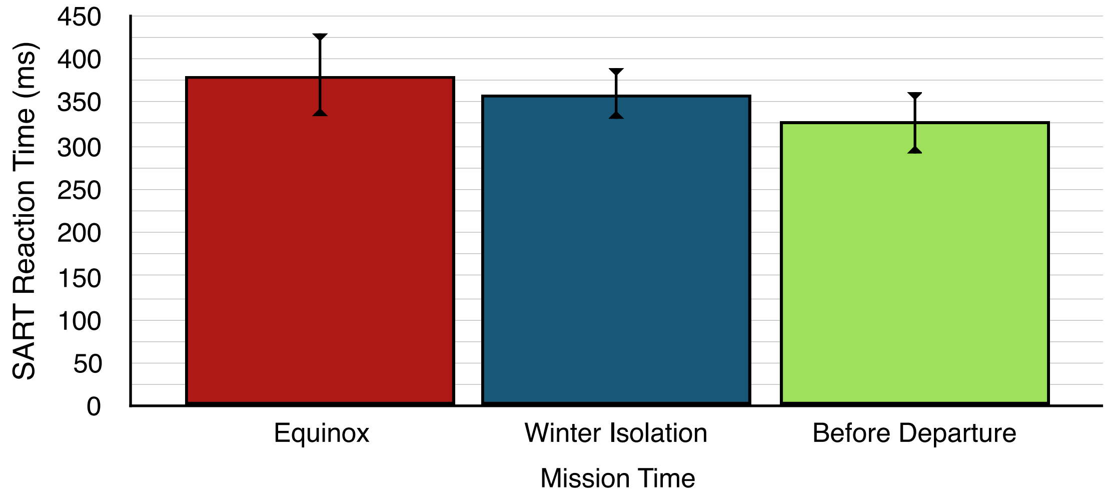

Figure 3.20: SART Reaction Time in Milliseconds at Equinox, in Winter Isolation and Before Departure.

The Explorers' SART Reaction Time improved over Mission Time: the average speed became less, i.e. faster, with a smaller SD. There were no effects on SART RT with regard to Group, Season or Testing Time. While my Explorers maintained a low inhibitory performance over time, their inhibitory speed improved. This implies a potential practice effect in the Explorers' SART performance because they maintained their accuracy but increased their speed. There was no speed-accuracy trade-off in their SART performance at any point but see below for the overall Group.

Marginally Supported Attention and Inhibition Models

A Friedman test yielded a significant main effect of Mission Time on **SART Omissions** ($\chi^2_{(2)}$=6.25, p=.044) but no seasonal differences were found employing Wilcoxon signed-rank tests. The Friedman test was unsupported by the BFHT. This effect was likely due to a single Explorer – Karol – producing high omissions in the SART.

There were no **speed-accuracy trade-offs** in the Explorers alone but when the Controls were included in the analyses, Spearman's correlations showed that with higher accuracy came a slower RT at Equinox (rho=.602, p=.008, BF_{10}=9.36) during Winter Isolation (rho=.624, p=.006, BF_{10}=11.41), and Before Departure (rho=.542, p=.020, BF_{10}=5.96). This explains the higher SD in the Controls compared to the Explorers as shown in Table 3.4.

For Mission Time's effect on **SART CV**, there was no evidence in classical NHST or BFHT.

In the case of **Auditory Attention**, **Sustained Attention** (TEA 2), **Selective Attention** (TEA 3) and **Cognitive Flexibility Accuracy** (TEA 5), there was also no evidence of an effect in classical NHST or BFHT. A brief explanation of this chapter's findings ensues, but a full discussion of them can be found in Chapter 7.

The question whether the cognitive functioning of Polish Arctic Explorers would change over the course of their mission is therefore: visual cognition such as learning, memory and reaction speed changed over mission time. Learning and retention improved in a manner that suggested practice effects in the Explorers and their Controls. Reaction speed to visual stimuli became faster while the accuracy of these reactions remained the same; the Explorers demonstrated poor inhibition of reactions in comparison to the Controls. Auditory attention and logical reasoning remained robust under conditions of ICE.

<u>3.4 What Has Been Learnt About the Explorers' Experiences over Mission Time With Regard to the Research Questions?</u>

This is one of very few studies in polar psychology which employs a control group at all (but see Bell & Garthwaite, 1987; Butcher & Ryan, 1974; Palinkas, 1991; Palinkas, (1987); Reed et al., 2001; Ursin et al., 1991) and the only one which focused on Arctic ICE experiences. As such its methodology is highly novel, making any of the findings an original contribution to science. Additionally, it has assessed mood and mental health more thoroughly than previous studies which have either focused on mood and inferred mental health from mood; or focused on a particular mental health domain such as anxiety or depression. The SCL-90-R provides insight into seven additional domains, making this study uniquely comprehensive.

With regard to the cognitive methodology, this study used assessments which have not been used in ICE before. This proved fruitful as the TEA and SART have clinical applications and can provide more information about the Explorers functioning than the previously used ANAM-ICE and NMRI-PAB.

With regard to personality, the Controls were more **open to new experiences** and the Explorers were more **extroverted**. This is somewhat counter-intuitive given that Steel et al. (1997) found that polar sojourners scored higher on openness, conscientiousness, extraversion and agreeableness than a normative sample. A possible explanation is that the Explorers completed the personality questionnaire when their confusion and vigor were highest, they had already volunteered for the newest possible of all experience by going to the station. They were excited to be at the station; and the interviews indicate that they were thrilled to meet new people there (see Section 4.4.1, *Thriving by Learning*). These differences emerged despite the groups' matched age, gender, and education; and despite both groups having migrated from their home countries to their current places of work or study.

Based on the presented data, the answer to the research question whether mood and mental health fluctuated over a Polish Arctic expedition is yes, they do change. Two particular **moods** fluctuated as mission time passed: **confusion**, and **vigor**. The Explorers were much more confused during the first summer measurement than were the Controls. Altogether, Explorers' confusion fluctuated more. These effects are likely explained by the fact that the Explorers commenced their mission during the first summer measurement: their confusion would be expected to be high in their new environment. Similarly, during their mission new and confusing situations such as the onset of polar night arose more frequently than for the Controls in their home environment. In the case of vigor, there was evidence in favour of Group affecting how vigorous the participants felt but no specific differences emerged. The BFHT did not supply evidence in favour of Mission Time, Season, or Group causing this effect. It also did not supply evidence in favour of the null models. It is possible that these fluctuations are caused by specific station life events that caused the Explorers to feel lower levels of liveliness and excitement. Figure 3.9 shows that the Controls' vigor was somewhat stable while the Explorers' declined over time.

In terms of **mental health**, depression increased over time and there was moderate evidence suggesting that this was due to mission time passing. No group or seasonal differences appeared with regard to individual the dimensions. The observed increase in **depression** is often attributed to the WOS (see Section 1.4.2, *The Winter-Over Syndrome*) but in the Explorers' case their most depressed point was after the winter isolation ended which is somewhat more congruent with the TQP as observed by

Sandal (2000) for example (see Section 1.4.2, *The WOS Across Cultures*). Mission time was also responsible for the fluctuations observed in **hostility** which was lower during the winter isolation than immediately before the Explorers' departure for home. This is also in contrast to the quantitative literature's findings but it has been suggested that some polar workers find it difficult to return home (Law, 1960). This may be the case in my Explorers. In their winter interviews, however, they explained that they were constantly suppressing their feelings of hostility towards others in order to maintain team cohesion (see Section 4.4.2, This Family is Fragile). The Explorers' **paranoid ideation** was higher in spring and during their winter isolation than just after their arrival. This reflects more suspicious and hostile attitudes towards other people as well as an increased need for independence in the Explorers. Given the descriptions of the team climate in Section 4.4.2 (*People Annoy Me, Privacy is Paramount*), this increase in paranoid ideation is unsurprising. **Psychoticism**, on the other hand, was higher during the equinox and spring phases than after their arrival. Symptoms of this dimension include everything from extreme social withdrawal to hallucinations. None of the Explorers reported hallucinations of any kind but their experience of the stressful workload and overload of people during September 2015 (see Sections 4.4.1, *People Are Problematic* and *Keep Going All the Time*; and 4.4.3, *Looking Back at Hornsund*).

However, the **amount of symptoms** experienced decreased in both groups from Summer 1 to Equinox and then remained stable. There was an unusual trend towards increased symptoms in the Controls during Summer 2. This measuring point coincided with the UK's decision to exit the European Union (EU) on June 24, 2016 ("Brexit"). Most of my Controls lived Britain as immigrants and even those who were British may have experienced considerably more negative symptoms following such a monumental decision. The same phenomenon was observable for the symptom intensity. In both groups, symptom intensity was highest during the colder measuring points which in the Explorers coincided with the mission mid-point. Contrary to the WOS and the TQP, however, the most intense symptoms were reported in the second summer. This suggests that the Explorers experienced the most problems immediately before returning home and the Controls experienced them immediately after Brexit. Based on this, the answer to the question whether the Explorers fluctuations' in mood and mental health are to be expected is no. The control group did not share their emotional fluctuations.

With regard to the question of cognitive changes over the course of a polar mission, the answer depends on the domains under investigation. There were little to no group differences in terms of **cognition**. **Visual learning capacity** was moderately affected by the seasons but more strongly affected by learning effects which suggests that any improvement here is likely due to repeated testing. **Free visual recall after a short delay** improved with regard to mission time passing, seasons changing and testing time. **For free visual recall after a half-hour delay**, there was some evidence in favour of all participants performing better when being tested for the second and third time. There was also evidence that there was an effect between equinox and winter but its nature and strength could not be determined. It is likely that these effects which are not group-specific are practice effects: despite the parallel versions being used, the participants may simply have learnt how to complete the test more successfully.

The only cognitive faculty where group differences emerged was **inhibition accuracy**. Here, neither mission time, seasons nor testing time produced significant improvement: group was the only explanatory effect. The Controls constantly outperformed the Explorers. This is a highly novel finding that has not been reported elsewhere. One possible explanation is the Explorers' constant self-monitoring (analysed in Sections 4.4.2, *It's More Difficult;* and 4.4.3, *People Annoy Me, This Family is Fragile*) which may have depleted their inhibitory resources and thus increased their commission errors. Further explanations of this are explored in Section 7.4. The Explorers' **reaction time** for this task became faster which implies a potential practice effect because their accuracy remained unchanged. If they had become both faster and more accurate, that would have been a practice effect; if they had become faster and less accurate, that would have been a speed-accuracy trade-off. However, no such trade-off occurred in the Explorers, this was only found for the overall Group. The possible effect on **SART omissions**, however, is likely due to Karol's increased amount of omissions in winter. Karol, as the leader, bore an immense amount of responsibility and in winter, he was mentally pre-occupied with worry over Albert's mental and Elwira's physical health (see Section 4.4.3, *Albert Left Us*; and Chapter 5). An increased amount of SART omission errors has been found with distraction which supports the notion that this effect was likely due to Karol's performance (Johnson et al., 2007). Karol’s overall concern for his team becomes clear when consulting online Appendix C, p. 72 where he details his thoughts.

4. How do the Explorers Experience their Environment?

This chapter answers the questions of how people in extreme environments feel and think about their lives, how they experience their physical and social environment. As such, it is an original contribution to science because such interviews have not been published in ICE literature previously. Appendix C supplements this chapter. It is approximately 160 pages long; to be more environmentally friendly and to make searching for extracts more convenient it has been supplied as a PDF online: https://osf.io/n894w/ .

I kept a reflexive journal during the January 2016 and June 2016 research phases. In September 2015, I kept a personal journal but it was not extensive. In short, I went through everything that was described in the literature over the space of a week: I arrived on Svalbard in order for my then-partner to end the relationship over text message, a family member being hospitalised with his third stroke, and I had an accident during which I fell and broke my coccyx. This made the first Svalbard experience much more intense than it would have been anyway.

Reflexivity rejects that a phenomenological researcher can ever become fully objective in her observations; it engages with the questions of how and why certain decisions were made in the research process. Here, I have provided some reflexivity so that my readers may be able to relate to my choices and how I came to make sense of my data.

4.1 Reflecting on Arctic Adventures: A Personal Angle

My fore-understanding of this research and its methodology began long before I began my academic journey. When I was around 10 years old, my parents gave me a book called “Ice Story” by Elizabeth Cody-Kimmel (2001). I marvelled at this re-telling of Shackleton’s *Endurance* expedition (1914-1917), supplemented with original photographs of the men, their animals, and their journey. I pictured the courage of the men, and their adventure. This desire for adventure never left me but it resurfaced strongly when, during my Master of Science at Edinburgh, I had to write a research proposal as a piece of coursework. I knew I would not enjoy this, and I knew that it was a “pass or fail” assignment so any effort would not even result in a rewardingly high mark. I therefore decided to propose the most exciting project I could possibly think of in order to inspire myself to do well. So I settled on writing a research proposal for what is now this thesis. To me, the polar regions had always held a sense of wonder and adventure which drew me to them. I was also certain that in order to successfully complete my PhD, I would need time outside my lab or my office in order to thrive – I am not an indoor person.

In preparation for this journey, I spent six months delved deep into the literature that you can find throughout this thesis. I was somewhat disappointed to find how much had been done already in Antarctica, and I was surprised to find that most publications reported negative reactions in the polar Explorers: depression, anxiety and so forth (see Section 1.4). While I could empathise with the causes of the negative emotional states, I could not close my eyes to my own, burning question: what was it really like to winter at the poles? My personal preconception of the polar regions was so enjoyable that I could not fathom that there should not be any joy in these missions, even though much of the literature suggested there was not. Hardly any qualitative research exists on polar Explorers (but see Wood et al., 2000), and even less on positive polar psychology. I therefore settled on a more open and balanced approach: I wanted to find out what these Explorers found extreme in their polar worlds. Not worse or better than in their homes, but extreme there. In my mind, months of no daylight and months of no darkness made a very extreme environment. At hindsight, this was perhaps too suggestive a question and a simple "Tell me about your life here." would have yielded richer qualitative data to analyse.

During my data collection appointments on Svalbard, I scribbled notes on my participants' behaviour, thoughts, feelings and utterances into my notebook and my reflexive journal. These were records of what happened between us as well as my thoughts on my, or their, behaviour. There are also detailed records of what I thought, how I felt, and how I reacted to polar night and the midnight sun.

My development as a researcher during this project was beyond anything I could have expected at the outset. During my first annual review, this project was highlighted as a "high-risk" project because the data collection involved travelling to Svalbard several times, among them in January 2016. The complications of this are outlined in Sections 2.1 and 2.2. I found my supervisors' faith and the knowledge that what I was planning was considered impossible inspiring, it let me thrive on any adversaries. Each time I went to Svalbard, I came back a slightly different person. It made me stronger in the sense that I learnt that I could handle isolation from home, confinement indoors, weeks of darkness, and weeks of light. This gave me a sense of accomplishment but also made me more self-confident because I had encountered what most of my friends from home saw as adversity and thrived on it. I had also succeeded in what had been considered a near-impossible, high risk project. I felt a unique, inspiring sense of adventure which carried me through my research year and made me happy. It is possible that this personal happiness is reflected in my interpretation of my participants' interviews, particularly the sub-themes of *It's Absolutely Amazing, Thriving by Learning,* and *It's Astonishing* which persisted throughout September and January.

It took me several months to transcribe the interviews and analyse the data to my satisfaction. This was because listening to them brought back many special memories for me that made me nostalgic and a little homesick for their company and the station. Some of the data – particularly Albert's contributions in Chapter 5 – were very hard for me to work with because of my participants' overwhelming unpleasant emotions. My proximity to them as "a friend and team member" while also being "their psychologist" and the "IGF interviewer" (IGF being their employing research institute) made it very difficult for me to maintain boundaries. I needed to reconcile fitting in with being socially accepted, being academically professional while procuring viable data, avoiding polar bear incidents, other risky behaviours, and coping with extreme weather conditions. I hope that my efforts to maintain boundaries and analyse the data with as little bias as possible will be visible in the ensuing chapter, and that it will illuminate for readers, polar Explorers and researchers the unique experience of a year at the Polish Polar Station, Hornsund.

4.2 Qualitative Participants

The demographic background of the participants was documented in Section 2.4. Here, their individual occupations, pseudonyms and interview lengths are presented.

Table 4.1

The Participants of the Qualitative Analysis.

Pseudonym	Team Position	September Duration	January Duration	June Duration
Karol	Leader	29min	29min	19min
Maria	Co-Leader	19min	27min	15min
Julia	Meteorologist	42min	41min	33min
Teo	Meteorologist	22min	32min	40min
Henryk	IT Technician	18min	59min	38min
Jakub	Oceanographer	18min	46min	25min
Jerzy	Maintenance	24min	32min	17min
Elwira	Seismologist	27min	23min	46min

Table 4.1 shows that the September 2015 interviews yielded the shortest amount of material (199min or 3hrs 19min), followed by June 2016 (233min or 3hrs 53min) and January 2016 (289min or 4hrs 49min). My participants indicated in their interviews that the winter time was most quiet for them

which explains why they spent more time on the interviews than in September and June. However, I think that interviewing them several times also increased their trust in me which resulted in longer interviews in June than in September. June was also a busy month for them but they sacrificed more time than they did in September.

4.3 Stages of Analysis

Before the analysis began, each interview was listened to while reading the transcript and it was then re-read a second time. My analytical process closely followed that described by Smith et al. (2009, pos. 1735ff). Its sequence is graphically represented in Figure 4.1 below.

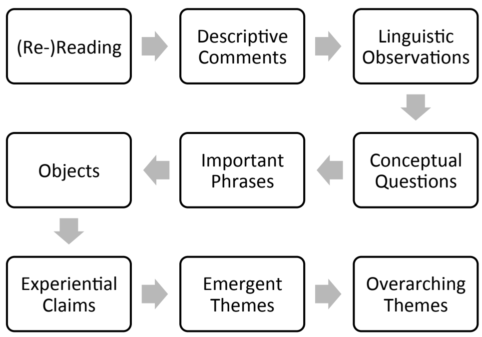

Figure 4.1: The Analytical Process.

Each stage of analysis is represented by a box. The transcript was read once per stage with the exception of "Emergent Themes" and "Overarching Themes". For "Emergent Themes", the transcript was read once per theme. "Overarching Themes" were extrapolated from all individual's emergent themes. This means that each transcript was read more than seven times.

Descriptive Comments summarise key aspects of each respondent's interviews to structure their thoughts and experiences without immediate, intentional attempts at interpretation by the researcher. I made these comments in black ink on the original transcripts. *Linguistic Observations* note whether any subject seemed more or less comfortable to the respondent based on their use of filler noises or filler words, hesitant silences or laughter. These observations also included any use of metaphors and comparisons as well as other aspects of language such as word choices. *Conceptual Questions* move away from the participants' explicit claims because the researcher's focus shifts towards a more overarching understanding of the material that is being discussed. These questions can often be answered by the content of the interview and were written in red ink on the transcript. Details of each stage can be found in Smith et al. (2009, pos. 1796ff). After these stages, I went through the transcript and underlined phrases which seemed important in mauve/purple, noting why they seemed important to me in the margins (*"Important Phrases"* in Figure 4.3.1). After this, *Objects* in the participants' world (orange) and the participants' *Experiential Claims* were highlighted (bright yellow).

These steps yielded *Emergent Themes* for a participant; extracts belonging to each theme were highlighted in different colours. From these, one *lifeworld table* was created for each interview. These focus on each person-in-context, relating to Heidegger's notion of humans as being out in the world with observable relationships to meaningful surroundings and context (Larkin et al., 2006). The lifeworld tables show the person's Emergent Themes and

Sub-Themes; and each participant has a total of three theme tables, one per season (September 2015, January 2016, June 2017). These lifeworld tables including extracts can be found in Appendix C on the Open Science Framework under this link: https://osf.io/n894w/ . The themes and sub-themes of each participant were printed and then cut into separate pieces. These labelled pieces were spread out on a table and re-arranged by my IPA supervisor and myself to form the group's overarching master-themes. This was done together and not by me independently because my IPA supervisor audited my work on this part of the study to ensure scientific rigour.

4.4 Analysis

The analyses here follow a chronological order, beginning with September 2015 and ending with June 2016.

4.4.1 September 2015

The participants had been at the station for a minimum of two months at this interview point. The exception is the oceanographer – Jakub – who arrived in May instead of July 2015, like everyone else. For September, my IPA supervisor and I made two attempts at finding overarching master-themes and we chose the second attempt. The first attempt yielded themes revolving around the group's struggles, the individual struggles within the group and separately, adventurousness. The three themes in Table 4.2 capture our participants' experiences more closely, however; that is why we settled for them.

Table 4.2

The Over-Arching Themes of the September 2015 Interviews.

Theme & Sub-Themes	Karol	Maria	Jerzy	Henryk	Elwira	Jakub	Julia	Teo	%
Surviving	✓	✓	✓	✓	✓		✓	✓	**87.5**
It's a Small World	✓	✓			✓		✓		50
Keep Going All the Time	✓	✓	✓		✓		✓	✓	75
People are Problematic	✓	✓	✓	✓	✓		✓	✓	87.5
Thriving	✓	✓	✓	✓	✓	✓	✓	✓	**100**
It's Absolutely Amazing		✓	✓	✓	✓	✓	✓		75
Thriving by Learning	✓			✓	✓		✓	✓	62.5
Who Am I in This World?		✓		✓	✓	✓	✓		**62.5**
Things I Know Already		✓		✓	✓	✓	✓		62.5
Open Questions		✓		✓		✓			

Surviving

The majority of the participants (87.5%) outlined numerous threats to the mission's success. These threats came in the form of the team's isolation and resultant self-sufficiency, dangerous field work, and close confinement with other team members. All of these things threaten the participants' physical – or literal – survival as well as their well-being and functioning.

It's a Small World

This sub-theme was particularly prominent among Karol, Maria, Elwira and Julia (50%). It shows how the difficulties of living and working in an inherently hostile environment – such as the lack of normality, dangerous wildlife and self-reliance under all circumstances – have shrunk their world. Maria summarised the situation:

> “We’re a society in a nutshell, let’s say. We need to process everything: like for example, burn the rubbish, see which tool is in which plant, the supply of food goes from the ship. It all requires a lot of technical knowledge, repairs, et cetera.” (Maria, September, 2015)

Maria’s use of metaphor implied that the most valuable object was the core of the nut: the station’s society which was encased by a tough shell of self-sufficiency to cope with the isolation from normal life. This isolation necessitated extreme self-sufficiency, so everything required meticulous planning. Just like an actual nut, this hard-earned shell of self-sufficiency served to protect its soft core: the vulnerable team. Their physical survival depended on careful planning of all resources; this required an increased competency to handle even the most basic tasks such as food storage. This showed how the world around them had become smaller, like a micro-cosmos: there were limited possibilities to replace broken tools or rotten foods which reduced the leeway for mistakes considerably. In the station’s small world, any negligence could be fatal. Julia described this in more detail:

> “And when you go outside, you have to prepare yourself for adventure. It’s not just like going..okay I go to the city centre to take a beer or to go shopping. No, here you have to put special clothes, erm, and prepare something hot to drink. And when you go for long hours outside, you have to have this erm…you have to plan if something it’s going bad.” (Julia, September 2015)

This extract shows very clearly just how hostile environment surrounding the nutshell really was: going outside inevitably necessitated special precautions to ensure one’s physical survival. “Outside” here did not just mean walking through the station’s doors, it referred to venturing beyond the station’s physical and social boundaries: beyond where one could easily be helped or rescued by other team members. Adventures required careful preparation and communication between those leaving and those remaining behind. The whole team had to consistently and coherently work towards ensuring each individual's survival as well as the overall team's professional success on the mission. There was a palpable pressure to actively keep the team alive and functional. The prominence of this sub-theme in Karol, Maria and Julia was no surprise: Karol and Maria were team leaders, Maria's scientific duty requires frequent field work and so does Julia's.

Keep Going All the Time

All participants bar Jakub and Henryk contributed to this theme. It was a direct consequence of living in a small, dangerous world: all aspects of work were key to success and survival and thus had to be completed with great dutifulness. Elwira pointed out how the recent arrival of the supply ship affected her duties:

> "Or right now, after *Horyzont II* came here, just doing all the groceries in a *magazyn* et cetera. So this is taking most of my time. Which is not really science-related and not really the amount of spare time I would think we would have." (Elwira, September 2015)

This extract shows that "work" encompassed not just the scientific measurements that the team has been contracted to do: they also have to unload the supply ship, store all supplies appropriately, process some of the fresh produce to be frozen, and renovate a hangar. This is in accordance with the society in a nutshell because the whole team had to contribute to these tasks. Additionally, everyone had to maintain their scientific duties, too, which reduced their spare time. A failure to maintain one's dutifulness would have posed a threat to personal as well as team survival, so there was little room for errors or laziness. Maria outlines how little choice the team has in performing their duties:

> "Because normally or even if it's night at home, you usually have the choice. And here you have to perform some tasks. So I think it's….maybe that's a bit scary: to keep the schedule and keep going all the time. Might be also because you have to spot those bears if you are around." (Maria, September 2015)

There were two threats to survival: firstly, had any team member failed at keeping the schedule this would have had unpleasant or dangerous consequences such as burn-out from trying to keep up or ostracisation from the team because of perceived laziness, if someone would not keep up with the schedule. This was a social survival threat with unpleasant but not life-threatening consequences. Secondly, a threat to literal survival was posed by polar bears who were ever-present in the minds of my participants.

Altogether, the overall experience at the station was characterised by an overwhelming pressure to maintain one's work ethic despite all hardships. The motivations behind this work ethic were to make sure that everyone completed their work, got along, survived (opposed to being eaten by bears or frozen to death during field work) and remained functional. The last sub-theme deals with the resultant issues with regard to human beings.

People are Problematic

All participants except for Jerzy and Jakub contributed to this sub-theme. In addition to the environmental and occupational threats to the team's literal survival, being part of a confined, isolated team posed numerous problems. These included accepting unexpected behavioural changes of other team members; experiencing summer team members' departures; coping with incompetence or carelessness of individual team members; the worry of one's personal impact on others and the lack of privacy. When asked for a dangerous experience with people, Henryk responded:

> "People, people, people, people, people. People are having experience with different kind of people. That's what I would say that ah, I know that if someone is not seeking excitement or you are…ahh.. how to call that, input from the environment, and has the input inside, that would mean that in a way you just don't need to forget about the place you are and I think that's a way of releasing stress. Just being that…that much outside means that you're actually too stressed to cope with who you are. For me one of the bad things about that is that for example you are not able to cope with your emotions, you try to get into alcohol. At some point. Because you need that thing all the time to forget." (Henryk, September 2015)

There are certain behaviours that make a person a threat to other team members: thrill-seeking and stress-suppression rather than active coping. What is dangerous about this is that a thrill-seeker may put themselves or others at risk which endangers everyone's survival. Alcohol as a means of coping with the stress of the society in the nutshell is particularly risky not just to the intoxicated individual but to everyone. However, passivity can also be very unwelcome. Julia sums up the effect of a careless individual's behaviour on the whole team:

> "Now [the cook]'s from March and he's like for long time so maybe he's not paying so much attention to his work. […] And then I had a shift. It was my first shift. […] And then, when I had the shift I went to the *magazyn* with the fruits and there were like seven or maybe eight big boxes with rotten fruits and vegetables. And I got very angry with him. Because it was a lot of…so this is why now. So this is as well why now I wanted to froze some and we had the big…long story. But you know the tractor? And it has the…like spoon for this? So we have thrown away one spoon and a half of vegetables that were totally rotten. And there was…like…no one…the vegetables are rotten so they are like fluids and so on, so it was in the *magazyn*, it

> was all very bad condition. And I'm vegetarian and it was like a big…bad thing. It was a bad thing that happened for all the base, all the people. And the guy, the cook, he was like "Why are you working?" because I started to clean it later. I ask another people to help me. And we were like 8, maybe 10 people from the base cleaning this during the night. And he was like "Why you are cleaning this? Now it's Sunday! Why do this?" And he's just like not responsible and he just…okay we have a lot of food. But he's cooking very…not using a lot of vegetables and meat and so on. He's not paying attention for…it's not healthy what he's cooking." (Julia, September 2015)

This extract shows that each individual team member has to make a conscious effort to do her/his best for the overall team to survive: here, literal survival comes under threat because the cook has been careless with the scarce fresh produce which results in unhealthy sustenance for the hard-working team with particular distress to the vegetarian team members such as Julia herself, Elwira, and Karol. This is not just a question of healthy sustenance for the team but also a matter of sleep: Julia and other team members ended up cleaning up after the irresponsible cook, sacrificing their sleep which meant that they would be tired the next day – possibly impairing their vigilance as well as their performance in the field. This would put them at an increased risk for a polar bear encounter. Additionally, each of survival's sub-themes involves someone mentioning the fresh produce which highlights how crucial having fresh fruit and vegetables is to the team.

The threats outlined by Julia and Henryk are very much threats to literal survival posed by fellow team members. Another key issue is that other team members always pose a threat to one's personal privacy. In September 2015, this is not seen a threat to literal survival but rather as a core need which is necessary to social survival, or endurance. Karol explains:

> "Sometimes one of us will try to leave and separate. I know I will need also…my room is separate place where I can come and I can think only about my problems about me. And everybody must understand that it's my place and they couldn't come in and you know…It's very important if everybody understand this. Everyone must have this separate place. Also in mind, also physically in person place, room like that." (Karol, September 2015)

Personal space must not just be accepted or tolerated by others but respected, almost revered. Personal privacy is very easily disrupted by an unwelcome knock on someone's bedroom door which constitutes a violation of this core need. People are thus dangerous to other people's personal needs.

This theme, although apparent in 87.5% of responses, was the only one where two contributors (Henryk and Elwira) openly admitted that they did not want to discuss the subject in further detail, this discomfort is rooted in the protectiveness each member feels over the team. Discussing the team's shortcomings would mean admitting them to oneself which would in turn result in thinking about them too much which could then lead to disrupting the team's functioning.

Thriving

This theme captures the aspects of my participants' lifeworlds which amaze and inspire them: the beautiful environment and the challenges of learning. All participants experienced aspects of this theme.

It's Absolutely Amazing

All participants bar Teo and Karol outline their experiences with their natural surroundings. Jakub, when asked to describe the "best thing" at Hornsund, said:

> I choose everything: surroundings, glacier, mountains, water. For me everything is extreme and really, I'm amazed because of every single thing. […] So it likes my dream really comes true. Yeah. It's freedom and it's…it's the feeling that I really do something what is important, what is interesting and what…yeah. (Jakub, September 2015)

Hornsund, to Jakub – and to Jerzy as well – is a dream that has come true. This relates to the dream-like Arctic beauty they experience here but also to the fact that they had wanted to winter in the Arctic from a young age. Now that they have arrived in their dream world, it is impossible to leave the station yet Hornsund is understood as "freedom". Given the circumstances, "freedom" at Hornsund means to be free from living in urban environments while experiencing nature. Jerzy in particular points out that in Hornsund, he is free from his familial duties which is one of the best experiences for him. For Elwira, on the other hand, the environment is a means of setting her free from negative emotions and moods:

> "On the positive, the surrounding is just brilliant and makes me want to go out more. And um, yeah like even if at some point you have like a worse day, you feeling more blue. I mean it's just looking out of the window and seeing reindeers and all that. It's excellent. It really cheers me up." (Elwira, September 2015)

My participants experience their natural environment as extraordinary in its beauty but also in its rarity. Their awareness that parts of their environment are not common – such as reindeers outside your window – increases the positivity of the overall environment.

Thriving by Learning

This sub-theme deals with the joy of learning. The only participants who did not contribute to this theme were Maria, Jerzy and Jakub. Interestingly, two of these – Maria and Jerzy – would go on to later struggle to integrate themselves into the group. The contributing 62.5% of the participants describe here how much they enjoy themselves when acquiring new skills or meeting new people. The exception is Karol who is concerned about his decision-making as leader.

> "Difficult, difficult speaking of challenges, I would say there is none. Because there is nothing difficult. I mean there are difficult things but that's what makes it really fun. Because then I need to learn something. In that way I discover a lot of stuff and I learn a lot every single day. […] Satellite communications, for example. Or using various tools that I've never had before in my hands. This is really amazing. That way I can solve that many more problems by myself because I know what tools to use. What else? Some electronics stuff, welding and stuff like that. That was also very cool. So, er, coming from like a guy who does programming and solving more abstract issues I would say and becoming more practical person, I love that. It's more a manual thing that I feel has always been missing." (Henryk, September 2015)

This extract is characteristic of how my participants thrived on their learning experiences. The challenges are perceived not as difficult but as a way of self-development which brings them joy and increases their self-confidence. It also makes them more useful to the team overall, as Teo says:

> "I've don't do meteorological science never. So my father was meteorologist and my mother…they meet each other. So it's very funny, so also I made the same. [laughs] And I'm trying to to get from my father as much as I can, to use it. But mostly I learn the meteorological here. Because the weather is different from Poland and here. And I'm trying to hmm…prevent other people said that you could do it better or something. I don't want other to tell me "You could do it better". Or "You made some mistakes" or something. I'm all the time trying to do my best." (Teo, September 2015)

Here, it is clear that gaining new skills is not just something enjoyable on a personal level that my participants could pride themselves in. It is also something that they gained new skills in order to satisfy their colleagues' expectations or standards. In a way, each individual worked towards becoming the best person for their team.

Acquiring new skills allowed my participants to thrive in different ways: their personal development flourished and they increased their value to their team at the same time.

Who Am I In This World?

This theme captures the questions and answers which participants have about themselves in their current situation.

Things I Know Already

Everyone except Karol, Jerzy and Teo contributed to this theme. My participants used self-observation to deduce new information about themselves in relation to other people at the station and the station environment. This theme differs from I *Learn A Lot* above because the learning of *Things I Know Already* involves coincidental self-observations in new situations rather than intentional skill acquisition. Elwira describes herself with other people:

> "We went out with Maria and Jakub on the zodiac. On those boats, big boats. Just collecting samples the whole day on water, it was quite cold. And towards the end of the day it got really choppy and the waves got much, much bigger. Maria was getting seasick. And basically it took us a long time to go back, we had some problems with the engine. I mean it was a very, very long, day and tiring day. And in the meantime, at the station, there was like a crew change. So some people left and some people

> got here. And of course, when I got to the station there was already like a small get together. A party. People were, you know, shouting and laughing, having good time. And you know, I kind of wanted to get back to the station, get some peace and quiet. And you didn't get that because there was already a lot of things happening…so it happened kind of few times already and so…this is why. […] And you know there isn't enough…there isn't much space apart from your room and you can you know find that peace to calm down, to regain the energy. Yeah, um…that was a little new for me. I thought I wouldn't…not never be too tired not to take part in a you know, in a get together. But I think, yeah, maybe that was something new. That I do need to recover somehow."

The combination of exhausting work and a close-knit society living in cramped quarters can prompt new and unexpected insights so far. Participants are reaching the understanding that the company of other humans can challenge them to a point of exhaustion, too. This prompts a learning-how-to-cope experience because other people pose an inevitable and unusual stressor for everyone.

Aside from this, my participants are using the hazardous environment to learn about themselves. Henryk, for example, has a rather close field encounter with a polar bear and uses this to deduce:

> "Already, I know how I would react when I would see a polar bear and I would be just a millimeter from shooting. And I know myself in that case. And I, I had quite a close encounter with polar bear. I had already my gun aimed, you know with the finger, it's just, I could just shoot and I didn't. And it's all good, it's all cool. […] We were just walking towards like a lot of rocks and that was like in our path. And there was something strange lying, and it seemed like snow but it was just too weird for snow at the same time. It was more yellow than white and It was like "No, it must be a polar bear.". And it was the distance like that. Or less than that. [gestures] […] I'd say like 25, 30 meters. Ah, and then we started talking loud, um. And the bear just didn't notice us. And at some point it did, and then the dog noticed the bear. That was kind of weird, because we were first, that's not how that should look. That's a dog, come on. So it stood up and looked at us and did like a step or two. Ahhh…and I noticed when he started getting up I already put my gun, it was loaded, ummm…I just..I was

> prepared to shoot. And I was waiting for reaction. And I asked Maria “Do you think, shall I shoot or not?“ and she, she said “No, no, not yet.”. And she was putting the flare at the same time. And if it started attacking, then we would have no way of actually deterring it. We would just have to shoot because there was nothing else to be used. It was quite funny. And then it went away, I unloaded my gun and just, we walked. And that’s it. It’s quite funny because I thought I would be more confused. We’ve got to do…but it was like fully mechanical, or automatic move. Like you know, just load the gun [imitates movement, makes clicking noise] and get ready. Aim. I’m quite glad, I’m quite happy with my reaction. I’m happy that I had that close encounter. I’m not sure if I would be happy if I actually shot and killed, rather than shot and not, especially because I am a person who doesn’t like people who hunt.” (Henryk, September 2015)

This is a prime example of how my participants are reconciling pre-existing knowledge about their personality (“I am a person who doesn’t like people who hunt”) with their behaviour in a new and dangerous situation (“it was like fully mechanical, or automatic move. Like you know, just load the gun [imitates movement, makes clicking noise] and get ready”) to reach a novel conclusion about themselves (“It’s quite funny because I thought I would be more confused”). This is an intricate example of this learning process and exemplifies that survival is the goal while psychological adaptation happens alongside it. This shows that my participants are developing a deepened understanding of themselves in this world: they learn more about their feelings and behaviours, as well as how to survive. This is a heightened experience of their selves which they find pleasant.

Open Questions

There are several profound insecurities that living at the Polish Polar Station brings. Their newly acquired skills and circumstantial introspection cannot yet solve these insecurities. Henryk outlines his unanswered questions:

> "How would I react? How would I behave? Am I going to be able to [other participant interrupting interview in Polish] so um, yeah. It's not that I want to prove anything to anyone or myself. It's just about trying to understand myself more. If I go into extremes and I have very harsh you know conditions, and I need to solve issues, would I give up or not? That's what I'm really interested about." (Henryk, September 2015)

My participants experience their time at the station as a unique opportunity for self-exploration and begin forming hypotheses about themselves. These thoughts always relate to themselves instead of other people, as Jakub worries:

> "my goal is just to see how I will be think here, about how or what I will be…I don't know how I will be, I miss the word. I mean if everything will be alright with me…or if I will have some depression…something like this." (Jakub, September 2015)

These explorative questions, hypotheses and worries about themselves are preparatory. They show how aware my participants are of the on-coming polar night and its unpredictable impact on them.

4.4.2 January 2016: Polar Night

For the January 2016 themes, my IPA supervisor and I made two attempts at finding themes by assembling and re-assembling the themes. However, we could not find a second set of themes apart from the ones presented in Table 4.3 below.

Table 4.3

The Over-Arching Themes From January 2016.

Theme & Sub-Themes	Karol	Maria	Jerzy	Henryk	Elwira	Jakub	Julia	Teo	%
<u>A Different Reality</u>		✓	✓	✓	✓	✓			62.5
It’s More Difficult		✓	✓	✓		✓			50
It's Astonishing		✓	✓		✓	✓			50
<u>We Cannot Choose Our Family</u>	✓	✓	✓	✓	✓	✓	✓	✓	100
People Annoy Me	✓	✓	✓		✓	✓	✓	✓	87.5
This Family is Fragile	✓		✓	✓	✓	✓	✓	✓	87.5
Privacy is Paramount				✓	✓	✓		✓	50
Sex Sucks							✓	✓	25
<u>My Hornsund Life</u>									100
My Roots in My Past		✓	✓	✓			✓	✓	62.5
Forming New Bonds Now	✓	✓	✓	✓	✓	✓	✓	✓	100
Good Things Are Coming				✓	✓	✓	✓	✓	62.5

A Different Reality

This theme captures how wildly different from normal life the Explorers experienced their lives at Hornsund. They acknowledged that while this life is *real* in the sense that it is not a hallucination, it is a distorted version of their reality from home. Hornsund reality has three main features: a heightened complexity compared to home, an amazing experience and an emulation of normal life.

It's Astonishing

This sub-theme conveys how amazing my participants found their work because of the natural beauty they experienced during their field trips. Jakub explains:

> "Er it's amazing that you can just go outside, er close door, sit on your snowmobile and go somewhere. And that you know, that there is Fjord water, open sea air, mountains, glacier and yeah, it's nice. Also, also er our way of working. I mean, if there is lots of work we can go on the glacier and spend there ten to twelve hours in, I don't know, minus fifteen/seventeen degrees temp- temperature, and we can er guess I can go- go on the water and drive somewhere and collect samples of do- or do some other research. But there are days when we just can er lie in our bed and er- and er we are able you know, to be free of everything, free of any duties. Er so it's er interesting that possibilities of going out, possibilities of you know, of that time that we can work, that we are able to work, or we aren't able to work. All of this is strictly connected with the weather conditions and the weather conditions is the main factor which can- which er tells you if you can go outside or you can- er cannot go outside." (Jakub, January 2016)

This shows that the environment and the weather had much more influence on Jakub's opportunities for work than they would have had at home. His Hornsund work was more enjoyable because of the stunning surrounding: it gave him a sense of pride because he was completing his tasks despite of the logistic difficulties and mental hardships. Overcoming these dangers in order to succeed in his research made him feel accomplished. At the same time, these harsh conditions occasionally absolved him of his responsibility to work because when the weather posed a threat to his survival, he could not go outside to collect samples. This creates a very positive work-life balance for him: when the conditions allowed for field trips, conducting his research makes him feel accomplished and he enjoyed the views. When the conditions did not allow for field trips, he did not have to deal with feelings of guilt because he was prioritising his own survival. What makes Jakub's extract shine is his thorough and genuine enjoyment of the difficulties of polar life which was pervasive throughout the whole station. Additionally, his delight in the rare and spectacular natural environment was very typical for my participants: Albert was the only one who did not comment on this.

It's More Difficult

There were, however, some inherent difficulties in this version of reality: easily-accessed comforts of normal Western societies are absent which increases my participants' responsibilities and their personal burdens:

> "[Hornsund is] Further away from the reality than a mirror. So it's like really, really deep mirror. Actually, we don't have shops. Everything what we can and can't eat is in our storage er room so, er we don't have, I don't know, pubs – no pubs, clubs and we cannot arrange any meeting with our friends, and we are talking with our families via Skype. So, for sure it's not real. It's not a real world and it's really far, far away from- from a real world." (Jakub, January 2016)

Jakub viewed Hornsund as unreal in the sense that he was at an unnatural distance from his loved ones and amenities. He had to deal with the emotional consequences of this distance as well as the logistics of arranging his own survival. To him, this was not real life because he was fulfilling a long-lived dream and because it was a distorted reality which lacked many aspects of reality. But also, acknowledging how real this life was might have forced him to admit the hardships more consciously which in turn might have made him feel worse and impaired his coping strategies. Regarding Hornsund life as a harsh but unreal and distorted reality allowed Jakub to place himself in this environment without distorting his experience of himself, his self-perception. This way, the world was abnormal and unreal, not he himself nor his behaviours, thoughts and feelings. A particularly unusual difficulty for Jakub was not shooting his co-workers, none of the others experienced this (see **We Cannot Choose Our Family**/*People Annoy Me* below). By seeing Hornsund as the extreme, he was able to distance himself from his thoughts which helped him function in the confinement and isolation of the team. Highlighting the extremity of the environment and living situation was quite common amongst the Explorers but very few admitted their aggressive urges the way Jakub did. There was a permanent sense of endurance and holding on to the most normal version of themselves that they could find in this abnormal reality.

Clashing With Normality

This sub-theme is a consequence of the distorted reality: my participants found that their new behaviours from Hornsund created a difference between them and what they considered normal:

> "Er that was actually really good because we made some dishes, like everyone made a dish for the Christmas Eve pretty much er, so you had this this common dinner that was really nice er, and some people thought've wh- about presents so we even got presents although I wasn't expecting. So that was- that was really nice, actually. Erm… and we're pretty much at rest over Christmas, there was not much happening because… you know. Yeah, so, on- on the Christmas Eve the weather was alright and I think the- the best experience was going to the, er peninsula called *Wilczek* with the cross er, for the, let's say, midnight mass. It wasn't mass obviously [laughs] but we still want to say it, but we just sang some carols [both chuckle] and, yeah." (Maria, January 2016)

This shows an attempt to emulate normality for the Christmas festivities. My participants wanted to re-create a sense of homeliness and togetherness as if they were the biological family that all of them were lacking at Hornsund.

Maria in particular felt a little lonely; this and Hornsund's abnormality led to her not expecting any presents from the others. She was delighted by the common activities in which she was included. Her loneliness is explored in the theme **My Hornsund Life.** Over time, the Explorers became aware that they were creating a "new normal" which clashed with the "old normal", even for everyday life:

> "when I was er I was with Elwira in Longyearbyen er we were seeing the doctors I was seeing the dentist and she was with- with her knee er and I was with my tablet and we were here in er er like reception and I put my tablet and I was walking for many hours later and there were in all the city and then I went for the- erm there is a, like small flat, small house of brother of Karol […] we had there our rucksacks and […] then I realised: "Okay, where's my tablet? I had it in the morning", and then "Oh, oh my God I have left it in reception in the- in the hospital!" and then after like I dunno five – six – seven hours I came back to look for my tablet and it was on the- on the- on the place I have left it. And it's like here I have left everything everywhere. Er, in the common space I try to be clean and so on. Erm, but for example my tablet I can leave it here or in- in the kitchen or in the erm living room. And not- I'm not worried about this and er I think that in the- in the future I can lose many things, because you know you leave your wallet in the supermarket and it would be not there after a few hours, you understand me?" (Julia, January 2016)

Regardless of its physical dangers, the station had become a socially safe environment for Julia. Julia trusted the others with her life and as a consequence, with her possessions. This particular trust did not extend to non-team members outside Hornsund, in the real world. Altogether, the Explorers saw it necessary to establish a normality resembling their home lives in their Hornsund world but when they succeeded, they found that the two realities clashed so it was difficult to switch between them.

We Cannot Choose Our Family

All participants contributed to this theme. It conveys that the team has not just developed the emotional proximity of a biological family but also accepted that they cannot exchange less popular team members or change undesirable traits.

People Annoy Me

This sub-theme deals with the general tension in the team. Everyone contributed to this theme either by outlining annoying behavioural characteristics or directly naming annoying people.

It was highly uncomfortable for participants to discuss this matter: everyone who named another team member as annoying showed signs of discomfort such as more filler words or longer pauses. Some participants explicitly stated that they would not give examples of annoying situations or people. This shows the immense effort that it took to hold the team together without major social disruptions. There were two people who were considered particularly annoying by several team members: Jerzy and Maria.

> "Ok er so ok I er er I think that they are not, er erm problematic the people that they- they are good people I think but er like erm er Jerzy and and Maria they have to like, erm, talk all the time, and er sometimes it's after- ok at the beginning it wasn't a problem er but er, when you are close er so much time er so it can- it can be just uncomfortable. And this is- this is the thing that er I have seen erm and erm, and not only me but er you know for example Albert or Elwira or er erm or Konstantyn they have the- the same er feelings it's not just er just- just me." (Julia, January 2016)

This extract shows that Jerzy and Maria were considered too talkative for the isolated, distorted Hornsund world which makes them uncomfortable company. The Explorers who raised these issues saw it necessary to justify themselves by highlighting that their experience of Jerzy and Maria was shared by other people. Karol, the leader, had noticed the issues between Jerzy and the group and considered intervening because a coherent group was necessary for a successful team:

> "I think I must talking little bit with Jerzy. Because Jerzy has a problem with the people. Ehhh…but he's a special man. He's…ehh…from another group, it's not the same group I'm talking about global group. The people it's not…he's little bit not passing for for for all group. And I see this. People has a problem with the contact with him. But he….but he's a good man. And I think he find a place here but I see that he is little bit escape…ummm…from the group. He's spending a lot of time with the computer and talking with the wife. With the son, with the family, the friends. Probably because ehhh…eh….he has not good contact, really good contact with the, with the people. But I can't help him. He must…understand ehhh…probably I will talking with him but now it's, it's a 50 years man, ya. He has…found direction in his life. In life. Ya. He's not like ahh…gummy, and people must be, in this group must be a little bit like gummy man." (Karol, January 2016)

Flexibility, in Karol' mind, helped people to settle in and fit in; Jerzy's lack thereof led to him not fitting into the team. A lone member outside the main group might lead to impaired team cohesion and functioning for everyone, not just Jerzy. This worried Karol. Being a part of the group instead of isolated from the team is highly important for any individual's happiness but also for the team's survival. Isolating yourself and annoying other people can be highly problematic:

> "[The tensions were] About everything. You were sitting next to that table, look on the person and think "Why the hell is she holding the spoon in this way?" For sure, he or she do this to- to irritate me.
>
> And to be honest, we are trying to survive and I mean to do not kill each other. To do not shoot to each other." (Jakub, January 2016)

Tensions and arguments were felt very intensely in this group, every small grievance can cause major emotional distress to any given team member.

Which brought in a different stressfulness: trusting team mates not to murder you when you annoy them.

Even though Jerzy and Maria were named as particularly annoying, it was clear that every person on the team would eventually annoy someone else during the mission. This was very much like a biological family in real life: you do not choose the members of the family you are born into, you cannot exchange them for other people you would rather have in your family and you have to accept that you cannot avoid them all the time.

This Family is Fragile

The Explorers were aware of the fragility of their Hornsund family. They constantly monitored and adjusted their behaviours to safeguard the family's happiness.

> "I see we spend a lot of time together. It's also good. I see people are coming to *messa* and sitting together and still laughing and talking for a film, looking, talking about blahblah." (Karol, January 2016)

The fact that people were *still* choosing to spend their spare time with one another in the living room underlines the fragility of this family: at any given disruption, they could choose to isolate themselves or an unpleasant team member. Karol as the leader was particularly aware of this fragility. The conversations made at this stage were not purely technical or scientific, people were also willing to engage in exchanges about their personal lives. Arguments were avoided through considerable efforts from all team members:

> "…when we try to avoid arguing… I think that we do it in the way of showing, or to try to show to everyone, er our greatest- greatest er things in characters, so this greatest things become to be normal […] it's really hard to say that er somebody shocked me

> because she or he is a great er friend- friendly or helpful or so on and son on because helpful and things like that become to- to be really normal because it's a very important to keep that start to fall of- er of not arguing atmosphere here. I think yes [every single team member makes this effort]. [If one person would not make this effort] I think that other people will collect themself in one group and er start to keep themselves together a little bit against this one individual- individual- against this one person which is individualist." (Jakub, January 2016)

This is a shining example of the immense psycho-cognitive effort the team made on a daily basis: it was not acceptable to display unwelcome characteristics at any given time. Only the best effort of each individual team member was accepted. The fact that everyone made this effort without explicitly agreeing to do so shows their shared understanding of their family's fragility. This, of course, was different from their families in normal life where unpleasant character traits might be tolerated more easily. To be a part of this fragile Hornsund family each individual had to make a great, active effort because it was not an automatic leap from being a team member to a family member. That was the fragility of the family: it was possible to socially expel someone from the family without physically removing her/him from the station. Such an expulsion would have resulted in great discomfort to everyone at the station and thus endangered their survival and mission success.

Privacy is Paramount

The result of this annoyance with one's Hornsund family members was an increased need for privacy. This need was so pervasive that any length that people went to in order to protect their own headspace was accepted: privacy had become a rare good that required protection.

> “I sometimes get angry a little bit. Erm, ee-erm well you know it’s like that’s not actually about that matter it’s just a general approach I’d say. But er I just tend to avoid, I ignore. I- I just step out, move out, leave - don’t talk, don’t watch, don’t listen. You know, I you know, I’m still at work and you know if I don’t feel like I want to er have someone in my close er, er proximity I just I don’t feel forced to. So, you know, I- I never like the idea of like forcing myself or like anyone forcing myself er into doing things so, you know it’s- er I’m not going to like er suffer listening to bullshit just because, you know [chuckles] we are here, the only eleven people. I- I just can’t physically force myself to listen to bullshit that’s- that’s- that’s- the issue. If there is someone who has nothing interesting to say I just don’t listen, that’s it.” (Henryk, January 2016)

Henryk had noticed a tendency to be more angry; the necessitates moving away from the anger-inducing stimuli. Despite polar night having inherent sensory deprivations such as darkness and confrontation with the same people and objects every day, Henryk felt that further deprivation of input was necessary to handle his anger. He needed to be away from the other Explorers and their thoughts, feelings, noises and general behaviour. This example shows a very common approach that my participants took when they felt annoyed by someone, or felt like someone invaded their privacy: they withdrew. This freely-chosen social withdrawal was not the same as being expelled from the family, or indeed expelling the offending family member. Each individual family member learnt that antipathetic thoughts and feelings towards others were destructive to the whole team and thus threatening to the mission. Subsequently, they learnt how to identify these thoughts and feelings; how to monitor them; and how to cope with them independently. This was done to avoid confrontations at a group level and to feel better at the individual level.

This emotional self-reliance was a key aspect of their experience because it was commonly understood that everyone underwent the same hardships (isolation from home, confinement with the team, a dangerous mission). These hardships were experienced at varying levels of difficulty by individual members but the overall understanding was that complaints about shared hardships were dealt with individually, rather than at a group level. That was because nobody wanted to intrude upon someone else's mind with their emotional struggles over the same experience.

However, not all privacy efforts were related to unpleasant experiences. Much rather, there was a shift in the team with regard to what was perceived as pleasant:

> "[The] amount of er parties of I don't know, meetings when we drink alcohol or something like that, when we sit together and to watch the film or something like that, decreased. Actually, I think that it's a time when everyone of us is looking for some er- looking for being allowed just to shut door and er sit in- sit in the room not only with- not… only with myself. Er of course it's funny when we sit together in- in our living and we talk or discuss and watch the movie or something like that, but er- but er it's much more rarely than in summer. I don't know if er it depends on polar night, or it's to depends on the period of time of our isolation that we are together in- in eleven people and you [Anna] are the first person from er Oct- October." (Jakub, January 2016)

While spending time together in the living room was seen as very pleasant during the summer, this was no longer the case in mid-winter: the frequency of social gatherings had decreased. Such gatherings were still perceived as enjoyable when they happened but the need for privacy had been prioritised over them by everyone. This privacy was achieved by being alone in one's personal bedroom.

Behaviourally, I could observe this need for privacy during my January time at the station. As a newly arrived team member, it was quite difficult to adjust to. Even though I had expected there to be an increased need for privacy, I was not prepared for the extent of this. For example, it had become socially acceptable to ignore someone calling out to you in a communal area. So it would happen that I was in the living room and I asked Julia a question as she walked past. Julia was not in the mood to talk to me so she would just continue to walk, not interacting with me. Similarly, if you were in a conversation with anybody and the person suddenly felt the need to be alone, she/he might just turn around and walk away without an explanation. This would be considered rude or hurtful by the left-behind conversation partner in normal life but at the station, this was just one of the necessities to achieve and protect privacy.

My Hornsund Life

This theme captures how the Explorers grounded themselves in their lives at Hornsund. Its sub-themes revolve around the team drawing on their past experiences to reconcile their present life with who they are and to form an outlook into their future.

My Roots In My Past

Part of grounding themselves in their Hornsund lives was disconnecting with their past. The Explorers needed to let go of their old connections with places which were not Hornsund, work environments that were not Hornsund, and people who were not at Hornsund. Teo described:

> "Christmas was different from… I've got- from my… life. Because away from home but er I feel here like in home. So the Christmas was- was fun. Erm… something [pause] er my family was calling me on Skype and [chuckles] er talking. I- I talked to each other and er even we've got our group pictures with me on the screen [laughing]. That was fun. So I don- I don't have something like huge missing about my family, I want to come home or… The time is here, moving fast and… you've got half a year to go so it's not forever." (Teo, January 2016)

Teo felt the differences between "Home Christmas" and "Hornsund Home Christmas" in an inclusive manner. His family included him in the family photo and he was content with this; his excitement about the station and future exceeded. To him, "home" had become where he was happy and while he had been happy at home, he was also happy at the station. The ties to many Explorers' home lives were not entirely severed but they existed only to a non-painful extent. So the connection with home was looser than it would usually have been but it was neither painfully close so that they constantly missed their families (but see Chapter 5 about Albert) nor was it so completely disconnected that they no longer cared for the contact. There was a balance between connecting to maintain the care for their families and disconnecting from them emotionally to continue to function emotionally at Hornsund.

Henryk had been looking for this disconnection from his home life for a very long time because he did not feel at home in Poland. For him, the disconnection from places prior to his Hornsund life came very easily:

> "I was I think I was erm perhaps I was now depressed, I'm not sure like how does that feel but I was er I- I- I think that I was really er like disappointed with how things work and I needed a break, er, erm go back home er try to rediscover what the idea of home you know and stay with my family for a while, and then make my decisions. And erm, erm… yeah I was- I was- I was- I was really disappointed… with how things

were but at the same time you know with myself erm, cos erm there is nothing that would come to me that was not caused by myself after all, right? So you know there was something that I was doing just wrong and I- I had to understand what was that er precisely, and er, I'm still not sure." (Henryk, January 2016)

Henryk had been unhappy with his life prior to Hornsund and his family was the main aspect of his understanding of "home". "Home", to him, meant the station and his family but not necessarily his previous life. He spent his previous life searching for a fulfillment which Hornsund gave him: the opportunity to thrive in difficulty while contributing to a purposeful mission.

As outlined above, Jerzy was struggling to fit in with the team. His connection to home was unusually strong, he video-called his wife every morning before breakfast and prioritised her happiness over some of his personal goals from the station:

> "Er, and maybe it's a loneliness issue that she- she felt so upset. Erm…Er, so she keeps convincing me to come back home whenever there's an opportunity like when there's a helicopter at the station, for example [laughs]. Erm, but yeah so she repeats it as a mantra but, er, I then argue back that she first agreed that it wasn't, you know, that we didn't talk about me coming here in first place, that it was my dream to come here. Erm, so because she agreed in first place she couldn't really, like, give the lollipop to the kid and then take it back [laughs]" (Jerzy, January 2016)

This extract shows Jerzy's struggle to balance his own life at the station with his marital life back home. In one way, he was fulfilling his dream of a polar winter mission but on the other hand, his connection to home was so strong that he could not fully enjoy this mission or find a place among other team members. His experience of the "polar lollipop" is almost as if his wife had allowed him the reward of leaving the family and coming to Hornsund after years of him contributing to the family life. Jerzy saw Hornsund as a highly rewarding experience and took great pleasure in his own accomplishments.

He made sure to highlight how much he enjoyed it in each interview. Altogether, before grounding themselves in their Hornsund lives my participants struggled with finding a balance between connection and disconnection from their past and their lives at home.

Forming New Bonds Now

As a result of their loosened ties with their home lives, my participants began grounding themselves by establishing closer connections with the other team members and their own work. They used self-observation to come to new conclusions about themselves and then anchored themselves in their team and their work. Hornsund slowly became the new normal for them, they felt safer and at home there.

> "I do like to spend time with people that for example I noticed, I'm one of those in the group who like to put people together. You know: "Let's do something together." Even if it's just watching a movie and such. Aaand so I don't think I was in such position before. Umm…what else? That I can take some time for myself and…it doesn't bother me. Like, just being on my own, that…that I don't feel the pressure like "I need to go out my room and spend some time with others. Because what are they going to say?". As I, I realised I'm not really bothered with that." (Elwira, January 2016)

Elwira became very conscious of her self-observations and then accepted them. She tied herself to friendly social interactions which go beyond what is normal among colleagues. Elwira had not previously seen that in herself, the desire for social gatherings and it surprised her. Similarly, it surprised her that the people around her accepted her necessary alone time. This made it more relaxed for her to demand privacy because it had become such a non-negotiable need. Each individual grew into the team to find a place for herself or himself in Hornsund by disconnecting from her or his past and connecting with their shared present: their friendships with the other team members and their work were the defining aspects of their identity. Hornsund became increasingly normal for them:

> "I at the beginning I was like ok look around there is a polar bear and now it's- I am not looking at this I just so used that there are no polar bears so it's just I am not looking around. And yeah many times I'm not- not so concentrated. Yeah I am less concentrated than- than before. Cos the- the things that I'm doing with my work it needs concentration but for five minutes and then I'm off for three hours so it's you know, for longer period of time I cannot concentrate for long period." (Julia, January 2016)

Life at Hornsund had become so normalised in people's experience that changes in cognitive faculties were noticeable and seen as unusual. Julia had become somewhat reckless with regard to polar bear safety and was aware that this was dangerous. She blamed the prior absence of the bears and her diminished concentration for her behavioural choices. The diminished concentration on the other hand was due to her shift work. This shows a recklessness in Julia but also a growing self-confidence: she knew what she was doing by now and could look after herself. Maria, however, struggled with grounding herself through professional and social connections:

> "I- I don't think I'm actually very close to anyone, erm… not in the way I would be to- to a friend I've chose in real life I say. Like… yes we are close in some things, we co-operate erm and we get on. But I am lacking this, kind of, having a very close friend. So yeah I suppose that's the only bit that isn't going so well for me."
>
> "I think for the sake of my own colmfor- comfort I tried to subside a bit and don't play the role if- that I don't have to er so I'm trying to sink in to become a member of the expedition [laughing] which doesn't always happen because there are situations where, where you have to react, takeover, whatever but they are less frequent now which is good." (Maria, January 2016)

In Maria's – and Jerzy's – cases, they maintained closer ties to people who were not at Hornsund because they were struggling to establish ties to their team members. Karol experienced Jerzy as somewhat unaware of these problems and Jerzy only reported focusing on his wife's well-being. Maria was very aware of her connection problems and tried to remedy them by forsaking her leadership role. Maria's continuing discomfort with her leadership role and her distance from the team saddened and isolated her: she wanted to connect to the others to be happy, it was difficult for her to find happiness in loneliness among a group of supposedly close people.

Good Things Are Coming

This sub-theme revolves around my participants' anticipation of their future at the station and beyond. People were excited for the next six months at the station because the sunrise on February 12, 2016 meant that they would be able to spend more time outside and explore more. Some participants had even gained a clearer insight into the future they wanted for themselves after the end of their expedition to Hornsund in June 2016.

The next six months were thought to be easier and more pleasant than polar night:

> "I think [the next six months] would be easier. The sun er will- will be on the- on the- on the- … on the sky er so we- we start, we- we start going on some trips, and er the other people, other regional groups, other er researchers and scientists will start to come here in April, and they will be here 'til summer so- so the period of time of our isola- isolation is going to finish. Er, so I think spring will be easier than autumn and the winter time." (Jakub, January 2016)

Polar night had been expected to be the most challenging part of their mission: its hardships are identified in the extract as isolation, confinement and darkness. The absence of the isolation and darkness alongside the reduction of the confinement are why the next six months were expected to be less stressful. Jakub in particular found the absence of light detrimental so the return of the sun and new people excited him (see Section 4.4.2, Good Things are Coming). In January, most Explorers felt excitement for more field trips, meeting new researchers and a new season, spring. They assumed that the hardest part of their mission was behind them and that now, the true fun of the mission would begin.

The darkness and quiet of polar night also gave the Explorers the opportunity to re-consider their lives up to this point. This brought them epiphanies in the form of new life goals which they would not have had, had they not joined this Arctic mission. Many of these new-found life goals revolved around further exploration of either the Arctic or other remote places:

> "…they are so many interesting er things around so I would like to stay in this region for longer. And er, my plan is that er I really started to like, like active erm active life and erm I know that I- for my plans the future and my dog, er I need er money for this and then I- I it's just I learnt here er to expect more from life and I don't want to er like come back and to be in the like er grey rely- reality. …maybe I would like to work with the dogs, here on the North so this is something that I- I really enjoy so for some time I would like to do, erm but this is like a short period of time. Ok I don't know maybe half of the year it depends on the- on the possibilities. And later I would like to look something in the university in erm- in er UNIS [The University Centre in Svalbard] er and er Spitz- in er Longyear or in Trømso or something- something like this." (Julia, January 2016)

This is a typical example of how Julia's home country no longer appealed to them in comparison to the Arctic. Their last six months at Hornsund taught her that she could achieve more than she had previously thought and she had an idea of what exactly she wanted to achieve and how to achieve it.

Julia and many others came to experience themselves as more capable than previously thought and did not want these newfound skills and abilities to waste away in a common society. However, this was combined with the desire to live a somewhat more normal life than at Hornsund because Longyearbyen (Svalbard) and Trømso (mainland Norway) are both towns with all amenities, they are not isolated research stations.

4.4.3 June 2016: Midnight Sun

This time point asked participants to reflect on their experience at Hornsund; the opening question was “How have you changed?”. Follow-up questions included “What was the best/worst experience here?” and “What would you do differently?”. For the June 2016 themes, my supervisor and I made two attempts at finding themes by assembling and re-assembling the theme labels of the individual participants. Our first attempt yielded themes relating to personal change, team cohesion and tensions, life at the station and thinking about the future. However, these themes did not capture the impression of instability and change the interviews gave; they seemed too generic and did not capture my participants’ experience adequately. Thus, we settled on the themes in Table 4.4 in our second attempt.

Table 4.4

The Over-Arching Themes From June 2016.

Theme & Sub-Themes	Karol	Maria	Jerzy	Henryk	Elwira	Jakub	Julia	Teo	%
My Self in Flux	✓	✓	✓	✓	✓	✓	✓	✓	100
Looking Back at Hornsund		✓	✓	✓	✓	✓	✓	✓	87.5
Hornsund Shaped Me	✓	✓	✓	✓	✓	✓	✓	✓	100
Shaping My Life After Hornsund	✓		✓	✓	✓	✓	✓	✓	87.5
Farewell to Hornsund	✓	✓	✓	✓	✓	✓	✓	✓	100
Albert Left Us	✓	✓			✓		✓	✓	62.5
Goodbye to this Life	✓	✓	✓	✓	✓	✓	✓	✓	100

My Self in Flux

My Self in Flux and its sub-themes are much more individualised than the other themes before because all my participants differed from one another to begin with and they have now integrated their shared experiences into their previous selves to form an updated version of themselves. This individualisation validates my phenomenological, idiographic approach to polar Explorers: despite sharing the same year, the same weather and the same extremes, each participant came out with a very different, personal experience and narrative.

This theme captures the feeling of instability in the face of the Explorers' fast-approaching departure from the station. They reflect on what their year at Hornsund has taught them, who they are now and on their newly set life goals. In that sense, this theme is somewhat similar to *My Hornsund Life* from January 2016. The main difference between the two is that in January 2016, my participants attempted to anchor themselves in who they were prior during the mission in order to survive polar night and the remainder of the mission. In June 2016, my participants have accepted that they can no longer ground themselves in their selves nor in their Hornsund experience: their selves have changed considerably and their Hornsund experience is nearly over. This gives an impression of my participants as being "up in the air", almost like an out-of-body experience where they are looking at their lives from a certain distance.

Looking Back at Hornsund

Here, my participants were looking back at their past experiences. This sub-theme is very diverse so that a generalisation between participants' responses is nearly impossible. Rather than selecting a single typical or atypical extract to represent the theme, I have gone with the approach of presenting at least one extract from each contributing participant (see Table 3.4) and cross-reference them where appropriate.

There were only two aspects which several participants experienced similarly: the best thing about having wintered at Hornsund was their field work, and the silence of winter made it the most pleasant experience. A common issue was the stress during the summer of their arrival:

> "[If I could change something] I wouldn't be so stressed in the beginning. [both laugh] Yeah, um…because…just realising how people are laid back about things. They don't stress as much as I would think they would. Ah…yeah, it would make it slightly easier." (Elwira, June 2016)

Elwira’s extract is a typical example of how many participants reflected on their Hornsund year. Their first summer was lived rather stressfully because of the workload; this was unpleasant because she aimed to perform perfectly. This pressure meant that she tried so hard to complete all her tasks – and complete them well – that she left herself exhausted and unhappy. She assumed that failure to comply would have resulted in reprimand from other team members, so each individual pushed their limits. An atypical summer stressor was Henryk’s frustration with how other people perceived his work performance.

> “[The summer of 2015 was hell] because of the pressure. Erm, a lot of work, erm, ten hours was like a minimum, er, I guess, and er, there was also, like, the lack of trust that I know what I’m doing. So a lot of people were telling me what they would do or what I should do while I had to prove, erm, that I know my stuff.” (Henryk, June 2016)

Henryk felt blamed and attacked for the slow internet connection at the station which he did not see as his fault. His inability to perform up to his team mates’s standards left him feeling angry and unjustly judged as incompetent: the internet problems were not due to a lack of skills on Henryk’s part. Rather, they were due to the fact that the entire team – around 30 people with at least one device each – were connecting to the same wireless network. This over-usage of the network in combination with unfavourable weather connections slowed down the connection. Henryk experienced his team mates as unjustly aggressive towards himself and struggled to remedy the situation.

Jakub’s reflections are very similar:

> “[The most fun and enjoyable experience was] Winter time. Winter time, polar night. Yeah I- when after summer, after really rainy season, the Autumn came and it started

> to be, er, very- er, very, I lost the word. It started to be calm, quiet here without lots of people, without lots of duties, without people who came to you to say, "Hey, help me, er, help me with this. Help me with other things; can you bring me to this point, can you bring me to the next side of the Hornsund. Er, can you help me to fix my boat, my engine," and so on and so on. Er, yeah, when the autumn came and the last people from- from Summer – part of expedition or from regional groups, you know, from some universities or something like this - leave us. When these people left us, er, it started to be really really calm and quiet. And it was also the time, when, er, when it was darker and darker and more darkness and, er- and er, the time when it was daylight here was shorter and shorter. Er, and the- it- these two things - I mean leaving of the people and this time with shorter daylight - it went parallel, parallel. […] and yeah that was my favourite time. And polar night, winter time when everything was lazy and, er- and er it was really quiet and it, er, there was also, er, very little, very small amount of things to do. Yeah, it was really, really nice." (Jakub, June 2016)

In winter, Jakub complained about lack of sunlight and how it affected him; but at hindsight this was the most pleasant time for him. What Jakub appreciated most was having personal space as well as professional space: he could focus on himself and his own scientific work because there were fewer distractions or people who needed help.

Some participants expressed things they regretted doing or regretted not doing but there were no typical experiences for this: Jerzy mentioned he wished he had exercised more and eaten less; Teo said he wished he had started earlier on his master's thesis. I would like to highlight one of Julia's regrets. She attempted two romantic relationships during her time at Hornsund: one with a summer team member, and one with Jakub from the winter team.

> "Erm, yeah I think that, er, since I'm, er, I'm a girl, I would not, erm… go with relationship with the guys, er, here. I think that it's erm mm mistake that I did… and erm, I shouldn't do this here. You know that- that the stories and I think that er, erm

> it's better not to do this. Ok I, er, I know that if I wouldn't have this experience that I have now, er, it could happen the same way. Er, but now I recommend… Er, for example my next wintering I will try not to make it trouble at least, er, half of year, the first half of year. Because later [chuckles] er, it's much better. I mean in the sense that erm, for example, if you start er relationship, er, in, er, February for example, it- it- it's just the end of wintering so it's like straight away er going home. And, er, and but not-not before" (Julia, June 2016)

To her, these failed attempts were very hurtful and it was difficult for her to continue living so close to Jakub after he rejected her. It complicated her healing process and disrupted her functioning as part of the team. Their quarrels were also visible to other team members and changed the team climate for the worse during the winter phase. This made Julia feel hurt and vulnerable on Jakub's part but it also meant that her feelings were exposed to other team members.

Hornsund Shaped Me

This sub-theme captures the changes each participant made to themselves deliberately or observed at hindsight. They share a sensation of completeness: their development here has completed, the mission has completed and they are ready to depart.

This sub-theme is again very individual, for example Julia and Henryk both reported that their stay at Hornsund changed what they perceived as important in their lives. However, what was now important to them differed greatly between them. Hornsund was the right choice for Henryk because he had been looking for a new orientation in life, a new society with new rules that he fit better than the previous one:

> "Erm, the reflection, the idea that er, I did right coming here, and I did right, er, breaking my er, quitting my job and career, finishing that. Erm, that basically the, erm,

> the feeling that I had for years, er, was right and I just did that too late. But- but- but now I know that, erm, that it was right to do, you know. Just, erm, leave technology behind and, er, and er enjoy nature and do something too, for nature conservation. I believe this is my new target, um, nature conservation and, like, ecology and also, erm, erm, communities like, you know, societies, small communities and trying to stop the erm, erm, like add a little bit, you know, of my work to re-starting the civilisation, er, from destroying what was left- what is left, basically. So, yeah, so I believe this is- this is- er, this is- this is what I want to do and er, well you know, if that means that I'm not going to earn a lot of money I don't care. Never- never cared so… […] I came here to run away from basically, er, maybe not town specifically but, er, civilisation. Er… erm, er society that, er, follows rules that I don't accept anymore. Used to, but I don't. So, you know, it's for me it's like, er, watching Babylon fall." (Henryk, June 2016)

Living at Hornsund – inside South Spitsbergen National Park – gave Henryk a deeper understanding of our planet's ecological vulnerability. Additionally, he experienced the overall human society as "destroyed" by greed, and Henryk saw this greed as exploiting our vulnerable ecosystems. As someone whose work previously contributed to such exploitations, this prompted Henryk to take apart and rebuild his whole life so he could dedicate his future to the well-being of the planet. Julia, on the contrary, became more focused on the positive aspects of the present and let go of old grievances:

> "For example, when I told you about, er, the cook, er, at the beginning it's like now, for me it's now not important at all. Er, I think that, er, I started to really live in the moment now like, be concentrated on what is- what is now and enjoy. And more over if- when we have just one month, er, to go, it's like I really want to be here, and I really want to, er, enjoy the days that we have, like to- to be active to… go see what is around, and so on." (Julia, June 2016)

At Hornsund, Julia's world shrunk from past, present and future to just the present. She delved down deep into the present to maximise her enjoyment of it. She let go of past grievances and focused on herself in the now.

Jerzy gave an example of newly-learnt behaviours. He had previously been unaware of his unpopularity. To him, fitting into the team meant providing well-meant advice to his younger and thus less-knowledgable colleagues:

> "I started controlling what I'm saying [laughs]. Er, so I'm not giving people a lot of advice anymore, er, and we call it the 'uncle-good-advice', kind of thing. So I'm not that anymore. Er, and that's maybe thanks to Konstantyn because we have good, erm, rapport. So Konstantyn is the kind of guy who would tell me when I go wrong but also will apologise when he feels he did something wrong. And I'm the same towards Konstantyn, erm, so that's why they can, you know, tell each other if- if something is wrong. And, erm, I also learnt to apologise when I feel that something, er, happen not well. And that it may be that for me myself it's nothing big, but I understand that it may be bigger for the other person so I go there and apologise." (Jerzy, June 2016)

Konstantyn helped Jerzy understand that his well-meant advice was not always well-received. Jerzy considered himself a well-meaning individual so he adjusted his behaviours to what Konstantyn suggested would be seen as well-meaning by their colleagues.

Towards the end of their mission, the team was preparing the station for the handover with the new winter team who would soon arrive. This, in combination with their looming departure, resulted in considerable stress. There were many additional, non-scientific duties to complete such as taking an inventory and the overall atmosphere was tense. Maria gave an example:

> "I'm more frustrated, more stressed, I've put on weight [chuckles] er… yeah… yeah… I don't even think I'm that nice of a person anymore [laughs] I'm quarrelling with people and I'm annoyed with them [chuckles] and I can't cope with what I've got at hand but, that's because there's a lot of it [chuckles]." (Maria, June 2016)

Several people gained weight which affected their emotional well-being, possibly because it affected their physical fitness in the field or because they worried about what their loved ones at home might think.

Shaping My Life After Hornsund

When thinking about their departure from Hornsund and arrival in Poland, my participants modelled their expectations based on Hornsund. The positive expectations revolved mostly around other people: the friends they had made at the station and the loved ones waiting for them in Poland. Negative expectations included a dread of no longer fitting into their previous lives: they were certain that they would or could not resume their lives where they left off pre-Hornsund. As a result, they wanted to re-adjust their future lives to include only the most valued aspects of their Hornsund lives. Teo said:

> "[I feel] Happy because I am going back and meet with people, Lilia, and family erm… I can eat some fresh foods I was waiting for, er, seeing some movie, go to the cinema, go buy something, erm… And here it's quiet, mm, no-one tell me what I have to do because I know my responsibility, and I'm trying to do it as- as good as I can. Erm, I can go somewhere and don't meet no-one. I- I will miss the freedom here I think… and the view… But I think the year is enough for- for now and now I can do something else – go back home and do stuff there and try to come back here." (Teo, June 2016)

Hornsund was still experienced as the ultimate freedom despite depriving my participants of their loved ones at home and despite not offering my participants the free choices of fresh produce or leisure activities. Freedom, at Hornsund, was the wilderness, the alone-ness and the professional independence. They perceived their lives as *alone* rather than *lonely* or *solitary* because loneliness and solitude imply a deficiency of something that the hermit craves. This something could be the company of other people or comfortable amenities. However, at the end of their mission my participants reported no such cravings or deficiencies; they felt that being alone in the wilderness of South Spitsbergen National Park was a desirable freedom that they would miss in Poland. Elwira saw it this way:

> "I think I will stay in touch with ahh a big chunk of our group after the wintering. I'm not sure if with all of them. Ahhh not because I plan not to catch up but you never know. But…yeah…we've being growing on each other. It will be difficult just to go back to the regular world when there's no other nine people around anymore." (Elwira, June 2016)

The problems with returning to what is the *regular world* included the lack of freedom but also the lack of the other nine team members. The regular world – despite containing fresh goods, loved ones, numerous leisure activities – was lacking continuous Hornsund team member contact and thus seen as deficient. My participants had gone from being acquaintances who worked together in September 2015 to an enforced family in January 2016 to close friends who genuinely appreciated one another in June 2016.

With regard to their futures, nearly all my participants expressed newly adjusted plans. What was important to them and what they enjoyed had been greatly shaped by their experiences at Hornsund:

> "Erm, but er I would like to have a job in Longyearbyen and then er, I've got- for me it's important you can go back sometimes to Spain or to Poland. But, coming back here and to enjoy the nature. But it's something er between- between wintering and between a normal life - it's what I'm looking, er, for now. […] I think that er, living in North Norway or in er, er, er in Longyearbyen it's, it could be, it could work because there you have erm, er flights and so it's like, you know one day or two days and you- you are home and/or in other places, and this is what we don't have here. It's one thing that I'm missing that sometimes you can have holidays and just go, you know, Spain or whatever. […] I'm excited with my er, I hope future job that it will be in er, with some travel company. Er, scientific background but it will be still people- people that they want to come here to- to see something and so on" (Julia, June 2016)

It was important to have a balance between the complete isolation of Hornsund and the perceived overcrowding of Poland. Four participants had plans to return to Svalbard in the future: Julia started to work for a tourist company in Longyearbyen three weeks after her return to Poland; Karol returned to his previous job as a bus driver in Longyearbyen; Jakub entered negotiations with the Institute of Geophysics to work with the station in the future, and Teo and his girlfriend Lilia planned to apply for the 40th expedition in 2017/2018. Living and working in the South Spitsbergen National Park had left Henryk, Julia and Jerzy with the wish to educate lay people about the importance and fragility of our environment.

Farewell to Hornsund

This theme is my participants' experience of parting from the life they have lived at Hornsund. There were two aspects to it: Albert – whose case study will be presented in Chapter 6 – left the station on March 1. The remaining participants had to re-order their life and cope with his absence. The second aspect was their looming departure to Poland and the joys and issues they were leaving behind.

Albert Left Us

This theme is split along the lines of those who knew Albert was struggling and would be leaving, and those who did not know. Julia was close to Albert and he had been talking to her about his issues:

> "I really like Albert and I think that he was like our child [chuckles] here. Er, he was very nice er however I think that when he left er it's more balanced… I think the- the situation and the station because he was really lost and when he left er it was I don't- I don't say that its better er, but it's more balanced, I think. But er, erm, er he was really into going out erm leaving the station, and er, since then we don't have such radical thoughts. I mean that okay there were some moments that I wanted to leave

> the station of- of course, erm, but er I never did this first step to do this. Sometimes I had enough of course, but er, but me and I think no one was so decided to go like Albert. And I think that if there is someone that erm, er it's so radical, I would say, er it can take more people, this direction. And like, er, some negative er feelings they can spread around one person and when this person's not er anymore in the group, erm, I mean thoughts about leaving the station and er he was negative in this er, er in this sense. Al- although I really like Albert and he's one of the- the people that I really I liked er in- in the station." (Julia, June 2016)

Julia felt responsible for Albert because he was so much younger than most of the group. His thinking, however, differed greatly from how Julia herself thought and from how she experienced the others' thoughts. She considered it best for himself and for the team that he left because she could see that he did not have the dedication to stay on the expedition. She worried that his radical thinking might change the atmosphere at the station. Karol concurred with Julia albeit for a different reason:

> "But I think that was exactly, because I was still talking with Albert "You must take decision. Not me. I can help you but decision is yours.". Yeah. And ahhh….yeah. Have been talking about this in December, January, February, in March Albert said no. He said "I must go out". But maybe that was good decision for, also to Albert. So…I don't know but I think it's okay, that was okay also for group. That was good for me because…I finished this this thing, and there was time for thinking about others' problems." (Karol, June 2016)

Karol was deeply concerned for Albert but did not hold himself responsible for Albert's feelings and decision. Albert was a frequent pre-occupation on Karol' mind; so Albert's final decision was a relief because it freed up headspace for other problems. He would have been fine with Albert staying and Albert leaving, Karol just needed to be able to stop worrying about Albert. Albert's indecisiveness impaired Karol' capacity to lead, in his own mind. Karol and Julia were prepared for Albert's departure and found it easy to accept the new team composition. Teo and Maria were among those who did not expect Albert's departure or know about his struggles:

> "In my opinion Albert don't show that he had some problems. Mm, for me it was, erm, weird because the worst time with, erm, done it - the polar night - I think this is the most difficult, mm… For me Albert was ok. I don't know, he- he want to… I think, erm, he is losing by staying here, this what he can do in Poland or- or do or mm… Things what he can do there." (Teo, June 2016)

> "I think it was difficult maybe that Albert left. Erm… particularly because I wasn't expecting it, like, it hit me at some point that it's happening. I- I think that yeah I was really sad after that. Erm, and it was quite a stressful time because two days after we had to call helicopter for Jakub, for his tooth. *[chuckles]* So it was like two people leaving in a row, I think that was really stressful." (Maria, June 2016)

Albert's departure was not taken as easily by team members who did not know about his problems. They respect his decision because they had no other choice but to do so. Nevertheless, they felt a sense of bewilderment and loss similar to bereavement. To Teo, the hardest part of the mission lay behind them and the spring and summer would be easier than polar night, so he struggled to understand why Albert wanted to leave. Maria felt a sense of loss and powerlessness because Albert left and she had not been able to help him; she similarly worried about Jakub who had to be hospitalised two days later. Elwira also outlined some effects of Albert's departure in more detail:

> "…you would think that eleven is a big enough, I mean it's a small group of people or maybe you can think that it's plenty. But either way, minus one is very noticeable. Really. Ahm. Just, there was an empty space in the group. Ahm. I mean, I really like Albert and we do chat a little every once for a while. Ahm. We…it took time to get used to the new group composition, I would say. Because, you know, you saw each other every morning ahm for breakfast and every afternoon for dinners and there, like, inside jokes that we had. You know, somebody was saying something by the table and we could instantly just look at each other, and we know what's [laughs]

what's happening, what we have on our minds. So, those…little bits…we're just missing. And yeah, it was noticeable. I think…I think as a group we coped with it fairly well. I mean…ahm…when it comes to workload I think it affected me the most because I took over all his duties. But ahm…socially, it affected everyone. I think it affected mostly people who are smoking because he was a smoker and ahm…and he was talking most with guys who are also smokers like Julia, Jan…" (Elwira, June 2016)

Elwira shared Maria's sense of loss: there was a space in the group that had been Albert's and could not possibly be filled by anyone else. This social loss had a greater impact than the loss of another worker; professionally, Albert's departure meant that Elwira took on his scientific duties and the general shift work was shortened by a day.

Goodbye to This Life

This sub-theme captures all the experiences that distinguished their Hornsund life from the life in Poland which they are returning to. The natural beauty and adventures were what they would miss at home while the lack of privacy and enforced confinement would not be missed.

In order for my participants to classify an experience as *extraordinary* it needed to stand out from their everyday life at Hornsund, not their everyday life in Poland. These situations were what would be missed by them, alongside the natural beauty of Hornsund:

"Er, for example, I went, erm, er, I went, er, to Warenhus when I want a house there that I want to go I think tomorrow again. And I went there with a snow mobile and, er, with the dog. Karol left me there, and it was the idea that I stay there one day. Next day there are few people coming and er we- we stay there for one, er, night more. Er, and it was erm, but they erm, the weather started to be very hard, er and then I er, I had to stay there alone, and I didn't have any contact with- with the people from the base. Er, I took the- the phone, the satellite phone and it was er, so, erm, hard blizzard, er that I couldn't er, call with satellite phone er to ask wh-, 'cos it was the-during the day it was ok, and then later the rain started to be- to be very windy and a lot of snow and very, very hard. And then, er, I tried to connect with them, I couldn't. And er then it was er and I had a small erm, er fire inside. Okay, I had smoke, because the- the chimney that I had, erm, mm, er, the, erm, the wood inside, and it was a fire. Er, however the chimney, er, it was so windy that erm, and er, erm, and then er, air was going, er, through the chimney and was blowing all the smoke inside. Er, so it was really, really dark inside, and then I had to go er outside, and it was a fucking- er that was a blizzard - it was very, very windy. And then I had to open the door and go smoke er away, er, but it was dark inside. It was- it was somehow dangerous situation. Erm, but I did this, er, I mean that, in a calm way. And then I open the, erm, open the door, er, take the gun, go outside, take a dog outside, er wait outside er, erm some time, and then go inside, then er stay there without er fire for a– for a night. But it was, I think that it was, er, more of almost fire in the cottage, in the blizzard erm, 'cottage-house', er I think that er it was the- the hardest experience. However, I did it." (Julia, June 2016)

This was one of many character-building experiences my participants reported. Usually, these experiences related to dangerous situations such as blizzards, or to accidents. They made my participants more knowledgable about themselves and about their environment. This type of experience was rare at Hornsund but nearly impossible to get in Poland, meaning that they would have to leave the opportunities for such encounters behind. While they agreed that not all these incidents were pleasant – for example, Teo hurt his back when unloading *Horyzont II* – all these experiences were valuable either as memories to be re-told or as lessons. Such experiences would be greatly missed at home.

Something that would not be missed was the impossibility of using certain coping strategies such as avoiding someone they had had an argument with or going for a walk to relax alone. These coping strategies were often employed by my participants before they arrived at Hornsund. Here, however, they were either too dangerous or would negatively impact the rest of the team. Elwira greatly missed them:

> "It could be something as simple as not being able to…when something upsets you, what I have that sometimes it just helps to take a few steps back, leaving towards the outdoors, going for a walk and just having some fresh air, et cetera. And the thing… that it was fairly impossible to do that in the winter. Because you could not just walk and not think about things because before you leave you need to put this armour, all the guns and all of that. And have the looks of people and you need to explain what you going to do, and they see that you're upset and you're going to be carrying a gun. And you're going on your own. And there are polar bears. And that probably because you are upset you won't be noticing things that you should or you going to be noticing too many things and you're going to be shooting poor Arctic foxes or something." (Elwira, June 2016)

This shows again that the individual team members put the overall team first: retreating outdoors by yourself would worry the others so much that she gave up on this habit. Other participants shared similar problems and looked forward to being able to employ these abolished coping strategies once again when home. Being able to place oneself first and not feel guilty about it because it affects your team members was something they would not miss.

4.5 Conclusions About the Explorers' Lived Experience at Hornsund

As mentioned previously, this work is unique in polar psychology because the semi-structured interviews concentrated on the Explorers' experience of their extreme environment rather than a particular psychocognitive impairment. Illuminating a polar crew's experiences of all kinds is an original contribution to science. The three different reflection points allow for the Explorers to make sense of their own experience in this particular moment but give the researcher insight into these moments as well as into the chronological experiences.Please see Figure 4.2 for the experiential model I propose based on these analyses.

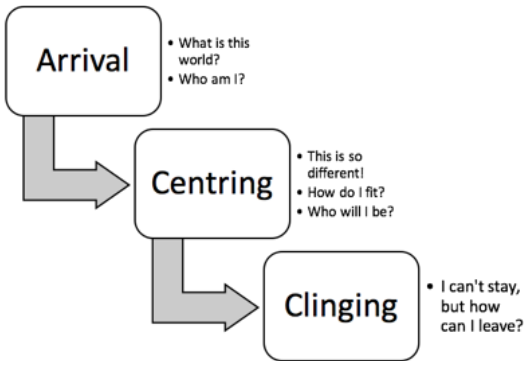

Figure 4.2 A Model of the Explorers' Experience at the Polish Polar Station.

When the Explorers arrived at the Polish Polar Station, they were confronted with a world that was entirely new for most of them. Even those who had been to the station before for shorter periods of time had to settle into the current routines and familiarise themselves with the summer team of 2015. People felt torn between surviving in Hornsund's difficult social and natural world, and thriving at their work. They tried to experience as much of the station's natural environment as they could and attempted to do their very best to thrive in it. What brought my participants joy was the great beauty of South Spitsbergen National Park and the acquisition of new skills from newly-met station members. There was a thriving exchange of knowledge and a sharing of the mesmerising nature. Learning about their new world and themselves in it caused an upheaval of whom they knew themselves to be; this was exacerbated by the immense workload at that time. The close cooperation with their colleagues was, unanimously, the most difficult aspect to them. Their co-workers were seen as co-workers, not yet as friends. The Explorers used these experiences to integrate new knowledge into their selves as they saw them and wondered how the overall expedition and particularly the polar night would affect themselves.

In January 2016, they had settled into this new world and began to highlight the differences between Hornsund and Poland. They found life at Hornsund more challenging because of their isolation from common amenities and the lack of freedom to move around. Again, the most difficult for all were the other ten team members. At this point, everyone had become aware of their own shortcomings as well as those of their colleagues. Now, they saw each other as family members because they had no choice over the selection of this crew and were inescapably confined to the station. This meant that professional cooperation and social integration between individuals were an obligation so vital that everyone chose to constantly be at their best possible behaviour. Each person aimed to be the best possible person they could be for their team. This resulted in them working hard to fit into the team and maintain positive or at worst, neutral relationships with their co-workers. This left them feeling stuck within the team but not at the station itself. Their experiences at the station also gave them new ideas about their futures and how to approach the next six months at the station. At the same time the beauty of the environment still fascinated them, especially the northern lights. This intense pre-occupation with their selves led them to reflect on their past behaviours at Hornsund or prior to arriving there, their present behaviours and experiences and how they wanted their future to be. Everyone was certain that polar night was the hardest phase of the mission and that the coming months with more opportunities for expeditions would be easier.

However, in June 2016 the participants considered the quiet of winter much more relaxing and less challenging than either the preceding or the following summer. Altogether, the Explorers were clinging to their Hornsund experience: they reflected on who they had been, who they were and who they wanted to be based on the hardships they overcame and the joy this gave them. They were ready to leave the station but not yet ready – or willing – to re-integrate themselves in Poland. This prompted them to plan changes to make their future lives more like their Hornsund life. These changes were often towards a more adventurous lifestyle, such as from academic career path to Arctic tourist guiding. They noticed that they themselves had become less concerned about their own safety as time passed, their lives at the station had normalised. My participants were sad to leave the natural beauty of Hornsund behind and the adventures that came with it; but they were looking forward to being able to use normal coping strategies for social stressors again. The confinement with their colleagues who became their family and then their friends had really been their greatest stressor. Leaving the station and its isolated confinement behind was something they looked forward to, the possibilities of going to the cinema or to a pub, to meet friends and spend time with their biological families. The station family was now regarded as friends as the group approached its disbanding.

These findings also address the question of mental health fluctuations over time: the winter is seen as highly stressful while it happens but afterwards, the Explorers reflect on their enjoyment of the peaceful quiet. Similarly, pre-winter, there is a sense of anticipation of it. Curiosity about the self in polar night plays a role in this, but also a longing for a more quiet time without the stresses and hectics of the summer team.

It is difficult to embed these findings in qualitative literature as there is so little of it. In relation to Wood et al. (2000), the findings were similar. Field work was seen as particularly pleasant by participants in both studies while problems with crew mates and sexual tensions were considered problematic. Maria's issues with her leadership role and her lack of a friend reflect the quantitative findings of Schmidt et al. (2005): female leaders struggle more than male leaders and than general crew members. Lack of available coping resources as described by Elwira has been mentioned before as problematic; while the successful resolution of challenges has been documented as salutogenic (Palinkas, Gunderson, Johnson, et al., 2000). Lack of privacy has led to an increased amount of time spent alone (Palinkas, 1992) but other complaints, such as gossip or clique formation did not appear in my study.

A closer integration of the qualitative and quantitative data will follow in Chapter 7.

5. “I Can’t Stand This Fucking Emptiness!”: The Case Study of Albert

This chapter contains data which arose over the course of the study but was not planned or even anticipated. It nevertheless relates to the questions of what makes a good wintering candidate, and how Albert experienced his life at Hornsund. This chapter presents the only case study in the history of polar psychology where the participant has given the researcher permission to write about their personal stressors which caused them to withdraw from the station. Consequently, empirical evidence from historical case studies will be employed as an introduction to this area of polar psychology. For reasons of confidentiality, no appendix is provided for this chapter.

5.1 The History of Polar Case Studies

Prior peer-reviewed literature has hinted at the frequency of participants requesting evacuation on psychiatric grounds: three out of Bell and Garthwaite’s (1987) twelve participants, and the only two winter evacuations from McMurdo in 2013-14 have been suggested to be based on suicidal ideation (Pattarini et al., 2016). This suggests that psychiatric evacuation is not that uncommon, yet no details are known of any of these cases. The only cases of whom details are known date back to the *Heroic Age of Antarctic Exploration (1897-1917).* In fact, these case studies are where polar psychology originates (Palinkas, 2003). and some will be outlined briefly below. They serve to show the severe consequences of unaddressed psychological complications and substitute the empirical literature.

Many polar Explorers kept diaries during their expeditions. They provided an option to record scientific measurements, remark on the environment, a leisurely pastime, and last but not least, publishable material upon return home. Often, several people collaborated on an official publication, for example Sir Ernest Shackleton's *The Heart of the Antarctic (1909)* contains chapters written by Shackleton himself, as well as Professor Edgeworth David, a scientist on the *British Antarctic Expedition* of 1907-09 (Roberts, 2014, p. 60). However, these official accounts, including later published biographies, often understate psychiatric issues to avoid embarrassing the affected individuals (Lugg, 1991, p. 32; Roberts, 2014, p. 49, 74; Taylor, 1998). Such issues can include anything from severe cases of what was then known as *polar depression* – a state of apathy, depression, and/or general mental debilitation caused by wintering over – to intra-expedition frictions and tensions. Either of these would shed unfavourable light on the involved which is why leaving them out entirely or making them appear less severe was common practice. This has consequences on how these Explorers are perceived, even today.

To illustrate this, consider the difference in accounts between *The Heart of the Antarctic* (Shackleton, 1909) and extracts of diaries cited by Roberts (2014). During the expedition, a team of three (the future Sir Douglas Mawson and Dr Alistair Mackay led by the aforementioned Professor David) was to sledge to the South Magnetic Pole. During their straining return journey, David appointed Mawson team leader. Officially, David described the reason as follows "…I thought it best for Mawson, who was less physically exhausted than me, to be in charge." (cited in Roberts, 2014, p. 74). Truthfully, "the Prof was now certainly partially demented," according to Mawson's diary (cited in Roberts, 2014, p. 73). Consequently, Mackay, fearing for the whole team's survival under such weak leadership "…deposed the Professor…the situation was now critical and he must officially appoint Mawson leader, or I would declare him, the Professor, physically and mentally unfit." (cited in Roberts, 2014, p. 74). This demonstrates the contradiction between the official version in which David claims to have resigned voluntarily from leadership duties due to physical exhaustion and the diary entries which reveal him as unsuitable to lead the team home safely.

Consequently, the following sections rely on diary entries rather than official publications and are divided into cases of polar depression and intra-expedition friction reported from both poles. They show why it is necessary to recognise and help afflicted team members, and why it is worth studying these individuals.

Polar Depression

Psychological debilitation, anxiety, and depression were frequently reported in diaries on both poles (Roberts, p. 156), and generally grouped under the term *polar depression*. Aside from the emergence of it during polar residency, mostly during polar night, no clear definition of it was proposed by any of the diarists. Whenever someone suffered mentally, they were seen as a case of polar depression. However, “mental depression” is also listed as a symptom of *scurvy* according to Scott’s diary on August 18, 1911 (Scott, in Jones, 2008, pos. 6469-72). No reference is made to the appearance of polar depression without scurvy on this occasion. This makes it clear that not all cases presented themselves identically, or even similarly, as the below diary evidence will demonstrate.

Mawson’s *Australasian Antarctic Expedition (AAE, 1911-1914)* and Roberts’ (2014) analysis thereof, provides a highly alarming case of polar depression: Sidney Jeffryes. Initially, Jeffryes became more aggressive and inclined to provoke fights, as Mawson describes it (in Roberts, 2014, p. 260), indicating that irritability can be part of polar depression. Over the course of the winter, this worsened. Jeffryes neglected his personal hygiene and began to collect his own urine in jars above his bunk, because he thought the expedition’s doctor was using it to collect evidence against him. He also accused his team mates of conspiring to murder him. The solution his peers employed in 1913 remained in-use for dealing with an individual whose psychological dysfunction threatened the community (Blair, 1991, p. 62): his team members placed Jeffryes in isolation and kept a guard on him at all times. At the time, he was deemed a case of polar depression by his peers, but Roberts (2014) came to a different conclusion: Jeffryes’ symptoms, including his paranoia, suspiciousness and aggression indicated a psychosis. An example of the underplay of psychological issues through the ages is how

Lugg (1991, p. 32) merely quoted Mawson describing a “relapse” of Jeffryes’ in Australia. Truthfully, Jeffryes spent the remainder of his life in different mental hospitals (Roberts, 2014, p. 292).

This case shows that team functioning can be compromised by a single person’s psychological problems during the polar night. It also shows that the frequent solution has been to isolate the afflicted individual (Blair, 1991, p. 62). It is a great loss to science that no such case studies have been published empirically. It is, however, also understandable why participants may not have permitted researchers to write about them; their team members’ portrayals of Edgeworth David and Sidney Jeffryes are unfavourable and unsympathetic. However, studying such cases may provide insight into how to support them to avoid evacuation or to relieve their emotional distress until evacuation is possible.

Therefore, I begin this case study by thanking my case study participant, Albert, for his courage: volunteering for this expedition required courage but I believe that his decision to withdraw from Hornsund, and to allow me to write about highly personal details in my thesis required even greater courage. He has read this chapter and made changes where he saw fit.

5.2 Case Methodology

5.2.1 Albert and his Controls

At the beginning of the study, Albert was a 21-year-old man who was appointed as the team’s geophysicist. He turned 22 during the equinox data collection. Albert had just completed his undergraduate degree in physics. He maintained a long-distance relationship during his Arctic deployment. Albert reported no pre-existing conditions such as depression or thyroid disease. He was at the Polish Polar Station from early July 2015 until March 1, 2016.

Like the rest of the team, Albert had a Time Control collected for him. This Time Control's data was pooled with the data from Case Controls for the statistical analysis. See Table 5.1 below for the demographic background of Albert's controls.

Table 5.1

The Background of Albert's Controls.

Demographic Variable		Mean (SD)
Age		24.33 (1.03)
Education		16.00 (2.52)
Marital Status		
	single	3
	unmarried relationship	3

None of the Controls reported prior depression or thyroid issues. Two were British, one was Malaysian, one was Singaporean and one was Greek. One did not to indicate his nationality.

5.2.2 Collected Data

Albert completed the After Arrival, Equinox and Winter Isolation measurements of the SCL-90-R and POMS at the station; and the Spring and Summer measurements at home. He also completed the Equinox and Winter Isolation interviews and cognitive tests. Albert's Time Control completed the study in line with all other Time Controls, so he completed the cognitive tests in Summer, too. The Case Controls each completed the NEO-FFI, SCL-90-R, POMS and cognitive tests once each.

5.2.3 Analytic Strategy

The analytic strategy addressed three questions that arose from Albert's departure: what was his experience of the Polish Polar Station, how did his experience differ from his fellow Explorers, and how did his experience differ from Case Controls? To determine the answers, Crawford et al.'s (2010) suggestions were followed using the program *Singlims_ES.exe*. For this program, the case's scores plus a control population's N, mean, and SD are required. From these, Singlims_ES.exe calculates the effect size z_{cc} which estimates the average difference of the case from this control population, measured in SD units. The effect size z_{cc} for the difference between Albert and the control sample, a 95% confidence interval for z_{cc}, the t-value, the one-tailed p-value (according to Crawford & Howell, 1998), the point estimate for the case's abnormality and the confidence interval (see Crawford & Garthwaite, 2002) are reported. Albert's cognitive changes over time will be assessed using *RSDT_ES.exe* which allows the comparison of a person's performance on two tasks (Crawford et al., 2010).

5.3 Analysis

The qualitative analyses precede the quantitative analyses because only they can answer the question of how Albert experienced the Polish Polar Station. A thorough understanding of Albert's lived experience is essential to this chapter and quantitative methodology cannot provide a personal enough insight. In Albert's case, I let his lifeworld from January 2016 guide my decisions on which quantitative analyses to run. When running quantitative analyses, hypotheses are necessary and the hypotheses of the quantitative analyses were based on Albert's descriptions of his experience.

5.3.1 Albert's Lifeworld in September 2015

Albert's lifeworld revolved around three themes: his life at the station, his life with his family at home, and the his co-workers at the station.

Table 5.2

Albert's Emergent Themes in September 2015.

September 2015 Themes and Sub-Themes	
The Real "Me" at the Station	
My Self As a Captive of the Hierarchy	Not Even My Work is Free
The Ghost "Self" at Home	
My Space in My Family	My Place in My Life
A Valuable Team	
The Good Group	The Janitor

The Real "Me" at the Station

Here, Albert reflected on his life at the station, and on the complications it held for him.

My Self As a Captive of the Hierarchy

Albert's thoughts revolved around his struggles at the station. He found it difficult to be confined with his colleagues on a daily basis, and did not enjoy the Karol' authority over him. Even though Albert appreciated Karol as a person and a father figure at the station, Albert worried about his own coping with the hierarchy:

> "And because I'm not a boss I have to, I have to fit to this system. I don't really like meeting every morning after, after breakfast and talking about what I'm gonna do and like…can explain myself. I hate explaining myself. […] Hierarchy. So, this might be a problem. And also umm.. I sometimes, I sometimes just can't deal with the rules somebody says…like saying…so I don't like it. Sometimes I can say "I don't give a shit about the rules" and "I don't like it" so I won't, I won't do it. But I haven't done it for this, this two months. So I hope I'm not going to do it. But it's also a risk so that's why I said I might be problematic." (Albert, September 2015)

Albert felt imprisoned at the station because of its unflexible hierarchy and schedules. Despite his dislike for this system, Albert liked Karol as a person and as his leader; and Albert liked his own work. He continuously made an effort to perform well and be what he considered a valuable team member (see *The Good Group* below). Albert's lack of autonomy over his personal and professional decisions was at the core of his experience. This lack of autonomy also decreased Albert's job satisfaction and sense of achievement: since he was constantly forced to explain himself and adhere to schedules, there was little room for him to achieve things out of personal drive. He worried that he might cause team disruptions in the future because of his dislike of the hierarchy, and because of his age:

> "well it might be problematic if you choose somebody who is 21 and well, in many cases I'm stupid child and I realise that fact. So it's a big responsibility, such a young guy and I think it is a big risk, right? Because if you're 30 or 40, you more or less settle. But I'm 21 and still there is a big hurricane in my head so…so it's a bit risky to choose a young guy like me for one year, right? I think so." (Albert, September 2015)

Albert experienced himself as less settled and stable than his older colleagues. He saw himself as less mature and considered this a risk to the mission, alongside his dislike for the hierarchical system. It was clear, however, that Albert did not wish to cause any problems, he was merely anticipating them.

Not Even My Work is Free

Albert enjoyed the satisfaction he gained from his job; completing his tasks left him feeling accomplished and valuable to his team. He was also pleased with his own performance:

> "I told you, I think I do my job rather well..ahh the people I'm working with and the people I'm working for they're all let's say satisfied and, and happy. Ahh…I did a lot of things. And I'm not…I'm not trying to avoid my job or other duties in the station." (Albert, September 2015)

His confidence in his professional competence and efforts was in stark contrast to his concerns about fitting in with the hierarchy. His professional confidence made Albert's life enjoyable at the beginning of the mission. However, his satisfaction with his own performance was also overshadowed by his lack of control over his work hours. This lack of control diminished his job satisfaction because he had no choice but to do his job. He wanted to do his job and his scheduled chores, but he would have been happier if he had had the choice to do so, rather than being required by the schedule. It would have been his preferred way of showcasing his best abilities and traits to the other team members; but as a captive of the system Albert struggled to thrive on the hierarchy and schedules. Albert was very dissatisfied with a particular team member's professional performance and how it affected his own life:

> “Let me come to my office, I’ll study, do my job when I want, do my like…do cool things like physics and my interests when I want, nobody controls me. And everybody is happy because job is done, Albert is happy. So yeah, that’s what I’m talking about. I don’t like it when people tell me “Okay, Albert, can you help me with the…”. [interrupts himself] No! No, that’s actually not true because I like helping people. I don’t like when somebody tells me “Okay, now you go to help somebody doing this and this. And you’re going to do this.” and I hate it! Because I have my job and I want, except this job, I want to develop myself and that’s one of the reasons I came here. And I don’t want to do stupid jobs somebody else is supposed to do. Like this janitor! He has so many duties he doesn’t do! Like taking this big heavy barrel of rubbish and throwing it to the fjord. He’s supposed to do it! No, I did it last time! We did it with Konstantyn, so we went. We lost a part of the quad so we had to bring a certain metal finder, so we found it in the sea. It took like fucking…two hours! And I lost these two hours! And it wasn’t even my duty to do it, right? I don’t like it. I don’t like when I have to do somebody else’s job.” (Albert, September 2015)

Here, it becomes clear that Albert was very willing to complete his own tasks and to help those who needed help. However, he did not enjoy being commanded to help someone whom he saw as lazy: the janitor. The janitor’s lack of effort with his duties showed a disrespect for the system which Albert tried to fit into so desperately. It crossed Albert’s personal and professional boundaries: the janitor made his own decisions to work or rest as he pleased, against the schedules and hierarchies of the station. These crossed boundaries upset Albert because someone else refused to adhere to rules which Albert also would have liked to do; but their refusal came with a lack of effort on the janitor’s part. Albert still wanted to make equal contributions to the team, he just wanted to choose to do them in his own time and place.

This hints at what the final theme (**A Valuable Team**) is going to explore: the value of any person at the station. Albert very clearly defined his personal worth by his professional competence, will to work, and ability to entertain his team mates:

> "I'm also a bit of a…well, as they called me once, a clown. But okay, I don't mind being a clown, if it's gonna help. If it's gonna be…starts to be a problem of some kind and it's gonna be uncomfortable for some people, of course I'm going to stop and be serious. Because I can. But…yeah…being let's say funny…which I don't…I don't find myself funny but when people laugh I'm okay with it." (Albert, September 2015)

Here, Albert demonstrated a clear will to fit in socially with his team: he was willing to contribute his sense of humor if the other Explorers wanted or needed it; but he was also willing subside if it would make their lives easier. Altogether, this shows that Albert was very self-aware of his own strengths and weaknesses and made an effort to manage them accordingly. He was also very aware of the team's wants and needs, and was willing to contribute to them. Albert disliked the systematic schedules and hierarchy, but – apart from the janitor – he liked his co-workers. They liked him, too, refer back to Section 4.4.3: *Albert Left Us.*

My Ghost Self at Home

This was Albert's self in relation to his life in Poland, and his relationship with his family and his partner. It is in stark contrast to his self at the station. While his self at the station was grounded in his work and his peer relations, his Ghost Self only participated loosely in his home life.

My Space in My Family

Albert was previously unaware how much he would miss his family, and how difficult this would be for him:

> "I talk to them like every few days and I really, really miss them. And one of the reasons I could say "Fuck this station, I'm coming back!" is that I'm going to miss my parents very, very much or my girlfriend very, very much. It's very hard to see your family in Skype and your dog and everything. And ahhh…I start to feel that I'm not, I'm not, I'm not a part of my family anymore. Because I'm absent. I'm just a ghost who appears from time to time in a computer. That's also a problem. So…I don't know. I really love my family, it's not like love but I need to be around them. I didn't realise that fact before I came here but now I know that it is a big issue in my life." (Albert, January 2016)

His lack of direct interactions and inability to engage in their daily activities such as meals led to an early-on disconnection from his family. Albert saw himself as a ghost because he could not contribute actively to their lives even though he would have chosen to do so. He felt somewhat powerless and disconnected. He had once had a place in his family where his Real Self had been: this was now being replaced by his Ghost Self because his Real Self was engaged at Hornsund. These feelings were exacerbated by the fact that he had no possibility to return in case of any family emergency which concerned him deeply:

> "And all these thoughts that my grandfather can die because he's old and something can happen. It's not helping, it's not helping if you think and you you know that you won't be able to do anything. You just get this phone call from your family and my dad or my mum is going to tell "Albert, your grandfather is dead." What I'm gonna do? I can't get to the plane because I'm in the middle of nowhere and even if I could, it's…that…the feeling that you can't go back even if you want, that is really tough." (Albert, September 2015)

Albert was very concerned for his elderly grandfather. His limited engagement with his home world led to his Ghost Self and the station life clashing: he made his best efforts to be a valuable team member and his fellow Explorers' experiences of him (see *Albert Left Us* in Section 4.4.3) show that he succeeded. But at the same time, his emotional focus and engagement were very much with his family and partner, not at the station. Altogether, this shows how torn Albert was between settling into his tasks at the station and maintaining the necessary emotional proximity to his family. This was a fragile balance for him to maintain, and it worried him.

My Place in My Life

Another aspect that Albert missed at the station was being around unpredictable strangers:

> "I can't fly…the the big thing I realised here that I need people to be happy and I need people to live. I thought "Okay, I don't need people because people around me are just making me crazy.". Now I realise I need them: I need to laugh at them, I need to see them, I need to criticize them but I need to be part of this life." (Albert, September 2015)

Albert found the unpredictability of human behaviour in cities very interesting and entertaining. It facilitated thoughts about these humans in his mind which he found fulfilling. His peers at the station, however, followed a set routine which he could easily understand and predict; this bored him. He missed the chaos of larger society. He felt like he had left his life behind which removed him from what he now came to see as his place. He had had a place among his family, in his town, and in his university and this place was now empty. His Real Self had moved to the station but the life at the station was not fulfilling to him.

A Valuable Team

Even though Albert was bored by the daily routines of people at the station and they did not provide entertainment, he appreciated and liked most of his co-workers.

The Good Group

What he appreciated most were professional competence and friendliness. Albert gave some examples:

> "Like Jan. He's a perfect personality for this kind of…adventure. Or Konstantyn. Or Elwira. Well, it's…maybe it's not about personality but it's also about the value that this person brings to the station. Because…people are always talking about personality. But if you're not a valuable person who can show off with knowledge or show a gain, it's really difficult. But if you are a valuable person, you can be sure that you're gonna be liked be the other members of the group. That is very important." (Albert, September 2016)

Albert valued his colleagues based on their active contributions to the team, rather than their innate personalities. It was important to him that they were competent at their jobs and worked hard because this helped to keep the station functional. While people's personalities might clash in their personal lives, keeping the station functional through their professional efforts was vital to everyone's survival and the team's professional success. Being liked by other team members depended on these efforts to become valuable.

The Janitor

There was one person who based on his insufficient professional contributions was not valued by Albert. Albert felt frustrated that he had to step in to do this person's job instead of his own job or spending his free time on things he enjoyed (see the extract in *Not Even My Work is Free* above). However, Albert also struggled with respecting the janitor:

> "And the problem is this guy is, I think, from time to time he can't deal with the fact that he's a like…let's say janitor? And I'm doing my job and somebody is doing their job. And I think maybe he can't deal with it. So we had like smaller or bigger…Difficulties and arguments. *[sighs]* And that's really hard for me because I don't like to argue with people and I hate when somebody demands respect just because of his age. It's stupid for me because you…if you demand respect because of your age, there should be something behind this age. An experience like a knowledge of life or something like this. But if it's just the age it doesn't mean anything. Only means, it only means you living in this world 30 or 40 years more than me but it doesn't, doesn't mean that you're smarter or something. So I hate it, I hate it, I hate that the …he always tries to show himself as the guy who knows best and it's really difficult for me." (Albert, September 2015)

The problem here was hierarchical in nature, Albert and the janitor were both at the same level of the station's hierarchy. However, the janitor treated Albert as if Albert were an inferior team member because of his younger age. Albert, however, felt that the janitor's age was not an appropriate reason for the janitor to elevate himself on a higher level. Albert mentioned previously that he struggled with being told what to do by Karol but here, the struggle was that the janitor was constantly suggesting improvements to Albert's work and behaviour when the janitor himself was not qualified to do so, not hierarchically positioned to do so, not valuable enough to the team to do so, and especially not invited to do so. To Albert, the janitor was crossing a lot of important boundaries; the janitor did not complete his own tasks as the schedules demanded and elevated himself in the hierarchy. The janitor was almost like Albert's nemesis in September 2015, he embodied everything that

Albert saw as problematic: baseless authority, lack of competence, laziness, disinterest in Albert as a person, and increased self-interest. This made his company very unpleasant:

> "If you're going somewhere with the janitor you always hear how cool he is, what what amazing things he's done in his life. And you…and you're bored after 10 minutes of this constant bragging. You can't brag in the station." (Albert, September 2015)

Albert here compared how much fun he had going for field work with Jan, in comparison to the janitor. Albert felt like the janitor showed very little interest in Albert's life or achievements during their conversations, and quickly became bored by the janitor's stories about his own life. This was particularly unpleasant because Albert saw the janitor's bragging as unjustified based on his insufficient contributions. The discrepancy between the contributions the janitor made and the experiences and achievements he claimed made Albert very uncomfortable.

Altogether, Albert experienced the station, its inhabitants and the daily life as challenging and stressful. It was not the workload or the type of work that he found difficult but rather settling into the station's routine, following a hierarchy and being away from his family. While many of the interpersonal interactions with most of his team members were very enjoyable, Albert's experience here was impaired by the janitor's behaviour towards him. The janitor's unjustifiedly arrogant demeanor enraged Albert.

If Albert's experience were integrated into the whole group's overarching themes (Table 3.2), it would contribute to the Surviving theme. Albert's extremes were focused on his efforts to cope with all the challenges he was presented with (It's a Small World, Keep Going All the Time) and on his interpersonal difficulties (People are Problematic). He was aiming to develop himself more and learn more but this experience was impaired by the strict schedule he had to adhere to, and by having to step in for the janitor occasionally. The janitor was Jerzy, and other Explorers described similar problems with Jerzy in January (see *People Annoy Me*, Section 4.4.2).

5.3.2 Albert's Lifeworld in January 2016

Here, the Ghost Self from September 2015 had become so prominent that his life at the station had become a Ghost Life. Albert had detached himself emotionally from his colleagues and focused on his family whom he missed dearly. Albert's detachment stemmed from a lack of recognition of himself in his own mind. He could no longer focus and retain information which robbed him of his job satisfaction, the one thing he was thriving on in September 2015. He was very aware of this and attempted to counteract it by studying and focusing on his research. Figure 6.1 shows Albert's Ghost Life.

Figure 5.1: Albert's Lifeworld in January 2016.

The most prominent aspect of Albert's experience – Missing Thoughts – is at the top, the remaining ones are ordered in clock-wise direction.

Missing Thoughts

Much of Albert's experience revolved around his sense of loss of his own mind's activity:

"But I-I-I feel like I lost so so much. It's, it's like instead of studying it for three years, physics, it's like I just finished high school. (sighs) And I don't know what to do with it. Because sometimes…er…before I came here I…I…recognised myself as a rather smart person who knows some things and that that my brain…sometimes used to…well, ahm…amuse me and shock me in a good way. I…thought about things and I created things in my mind. I was kinda impressed but now it's, it's, it's nothing like that. The last good idea I had was two months ago. And now, I just feel like I'm everybody else, I'm not thinking, I'm just doing things I have to do. And there is nothing cool in my life anymore. I, I, I don't amuse myself; I-I don't say jokes to myself anymore. Of course, I, from time to time I laugh but it's mostly because of this situation not the imaginary situations I cr- used to create in my mind. Sooo…

everything changed. Everything changed. Because I-I-I-I-I got stupid somehow. In-in-in three months, I got stupid." (Albert, January 2016)

He felt that he had lost much of his knowledge that he gained in his university degree which frustrated him in a professional sense. He felt as if he had become stupid, compared to September. And since his professional achievements were what gave him joy in September, this led to Albert losing the enjoyable aspects of his life at the station. Additionally, he had lost the ability to entertain himself in the face of the boredom of polar night's routines. Albert's profound sense of loss led to him desperately grieving for these abilities. He described that he struggled to retain anything that he read; this made it difficult to find entertainment as well as acquire professional knowledge through publications. The above extract shows that Albert – despite being proficient in English – stammered when discussion a particularly emotional topic. As he did not stammer in September, this is not indicative of a speech impediment, it is rather a sign of his emotional grief. Albert hoped that his cognitive abilities would return if he returned to his life in Poland, with his family and his university degree. He was, however, uncertain.

Missing Things

Albert attributed some of the missing thoughts to missing aspects in his life, such as people to observe and wonder about.

> "And also, people, I didn't realise that even watching people in a pub, in a tram, on a bus, on a street, everywhere that that creates thoughts. It creates thoughts. I don't have thoughts right now. I don't have thoughts! I used to have so many thoughts! "Why those

people act like this?" "What do they do?" "Why do people walk like that?" And I thought. But now I don't, I don't think! I-I think only about stupid things. I have to do the measurement, I go do the measurement and that's it. And I go back and I lie down and I don't think. I can't stand this fucking emptiness." (Albert, January 2016)

Even though he had his colleagues at the station, they did not suffice to continuously inspire Albert's curiosity. Albert and all his colleagues had settled into their professional routines of fulfilling their duties which made life very boring for him: he knew what his colleagues where doing, when and why. This lack of wonder, and absence of people to wonder about, created an unpleasant emptiness in Albert's head. He was missing his thoughts as well as the aspects of his life that used to inspire new thoughts. He felt un-challenged and this lack of challenge what was made it difficult for him at the station. This new situation in his head made it very difficult for Albert to be happy at the station, he was clinging onto the hope that he would feel better soon. Additionally, his engagement with his colleagues had declined.

> "I can predict everything and I don't feel interested in any of these people! Konstantyn is, is, he's fun. I like spending time with him because he's he's fun and it's nice to talk to him but anybody else just…these people could disappear and it wouldn't make me feel any worse or better, in this situation. I feel like I'm ghost and I treat them like ghosts. They don't do anything that affect my life, that makes me better or worse." (Albert, January 2016)

This is similar to what Albert experienced in September: the established routine of the station's team bored him because everyone and everything was predictable. While the other team members described their interactions as profoundly difficult (Section 4.4.2 People Annoy Me); Albert saw his colleagues as irrelevant to his life and his happiness. They did neither impair nor improve his emotional state, even the conflict with the janitor had become meaningless to Albert.

What Helps

Albert actively pursued scientific activities aside from his station duty so that he would feel better. These activities were future-oriented, for example he was writing research publications to boost his CV, and university applications. They reminded him of the time when his cognitive faculties were still normal and simultaneously filled him with the hope of their return after the end of the mission. Additionally, Albert refused to participate in recreational alcohol consumption at the station because he feared that he would lose himself entirely if he did. He was worried that he might not recover from any effects alcohol might have had on his emotional state. When asked to rate these activities' importance to his well-being on a scale from 0-10, he replied:

> "Well…if I, if I didn't do them…I don't even wanna think what will happen to me so I'm gonna say 10. But…maybe it's very personal to look at that. You could say it's 0 or 1; but for me it's 10 because otherwise I really don't wanna think what's going to happen to me." (Albert, January 2016)

This shows that Albert was very worried about his own state of mental health: he perceived it as fragile. The biggest threat to his mental health was the lack of input he experienced at the station because it facilitated a type of boredom and emptiness Albert found difficult to handle. Since this boredom was innate to the station, and the emptiness was innate to his mind, Albert attempted to fill his bored mind with research-centred activities.

Escape to Life

Albert considered to abort the mission and ask for an evacuation due to his problems. He wanted to return home, which was met with some resistance:

> "When you deal with these problems and you realise what is most important thing in your life and that your ambition's to be…winterer or to be the youngest winterer, it all doesn't matter. And I don't, I don't consider my decision of leaving as a mistake, as they told me. And I know I'm not going to regret it. And I don't consider my decision to come here as a mistake because if I didn't came here, didn't come here, probably I wouldn't know as much about myself as I know now." (Albert, January 2016)

Karol – as Albert's team leader – was concerned for Albert's professional future and how aborting the mission would affect Albert's chances of gainful employment in Poland. Albert, however, was certain that leaving was his only choice to re-gain his happiness. He had realised that his family and his university life in Poland were of utmost importance to him and that his time at the station was wasted because it did not bring him any closer to his scientific goals. The station life did not bring him a sense of accomplishment or pride, the way many other winterers described (Section 4.4.2, It's Astonishing) but the exact opposite: deprivation of stimulation, impaired capacities and even a loss of past accomplishments. Albert's wish to return home was profound and he could not see the point in remaining at the station.

Albert described a sensation of deprivation along a lack of fulfilment. He reported very little concern for or engagement with his peers at the station, but felt a deep longing for his home in Poland. He perceived the station life as boring and his own mind was unable to help him alleviate the boredom. This dysfunction was very distressing to Albert because he could no longer recognise himself in his own mind. While it did not affect the quality of his work it affected his quality of life and he made great efforts to improve his life at the station. He engaged in cognitively challenging research activities and focused on his future after the station. However, his loss of the ability to retain written words in his memory frustrated him. He was somewhat anxious that his cognitive faculties would not return because he did not see them as a result of the polar night. These behavioural changes between September 2015 and January 2016 are also noted in my reflective journal:

> "Albert's change is entirely shocking. He's considerably slower and less motivated than in summer. I'm horrified and worried." (20th January 2016)

Based on these, the hypotheses for the quantitative testing was that Albert would experience more Depression, Confusion, Psychoticism and Anxiety, as well as less Vigor than the other Explorers and his Case Controls.

5.3.3 Albert's Personality

Albert's personality differed significantly from that of his fellow Explorers, see Table 5.3.

Table 5.3

Albert's Personality Compared to the Explorers and Case Controls.

Personality Traits

Trait	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
Extraversion	9	29.9	3.14	23	-2.09	.035	3.53	0.03 to 17.39	-2.20	-3.42 to -0.94
Neuroticism	9	18.1	7.61	36	2.23	.028	97.19	84.87 to 99.99	2.35	1.03 to 0.06
Trait	Case Controls			Albert	Significance Test		Estimated percentage of the Case Controls obtaining a lower score than Albert		Estimated effect size (z_{cc})	
Neuroticism	6	17.00	7.64	36	2.30	.035	96.52	78.14 to 99.99	2.49	0.78 to 4.16

Only 3.53% of Explorers described themselves as low in Extraversion as Albert, showing that he was less out-going than most of the others. He described himself as higher in neuroticism than 97.19% of Explorers and 96% of Case Controls. This implies that Albert was more prone to worry about his life and experience than almost all Explorers and Case Control.

5.3.4 Albert's Mood

Albert's lifeworld suggested a loss of joy and meaningfulness, as well as severe problems with his cognition and social disconnection from his peers. On account of this, his Depression, Confusion, Vigor and TMD were compared to the other Explorers and his Case Controls.

Table 5.4

Albert Felt More Depressed Than the Explorers and his Case Controls After Arrival, Equinox, and Winter Isolation.

POMS: Depression

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{CC})	
	N	Mean	SD		t	p	Point	95%CI	Point	CI
After Arrival	9	2.22	3.15	13	3.25	.006	99.41	94.99 to 99.999	3.42	1.64 to 5.18
Equinox	9	1.22	1.30	16	10.79	<.001	99.99	100.00 to 100.00	11.37	5.89 to 16.87
Winter Isolation	9	2.00	2.35	16	5.65	<.001	99.98	99.88 to 100.00	5.96	3.03 to 8.89
Season	Case Controls			Albert	Significance Test		Estimated percentage of the Case Controls obtaining a lower score than Albert		Estimated effect size (z_{CC})	
	N	Mean	SD		t	p	Point	95%CI	Point	CI
After Arrival	6	1.82	1.72	13	6.02	.001	99.91	99.46 to 100.00	6.50	2.55 to 10.48
Season	Case Controls			Albert	Significance Test		Estimated percentage of the Case Controls obtaining a lower score than Albert		Estimated effect size (z_{CC})	
Equinox[1]	6	1.82	1.72	16	7.63	<.001	99.97	99.95 to 100.00	8.24	3.28 to 13.26
Winter Isolation[1]	6	1.82	1.72	16	7.63	<.001	99.97	99.95 to 100.00	8.24	3.28 to 13.26

Notes: [1] The Case Controls' average for Equinox and Winter Isolation are identical because Albert's Time Control reported the same level of Depression at these points. Because Albert's score was also identical at these points, the results for them are the same.

Effectively, Albert described his mood as more depressive than nearly 100% of both control populations; this indicated that his depression levels were unusually high for a Polish person wintering at Hornsund, and for a person of Albert's age, gender and educational background.

Albert experienced more Confusion than his colleagues at Equinox and during Winter Isolation. His Confusion was also higher in the Summer, when he was at home and they remained at the station. This fits with his own description of having a "big hurricane" in his head from September 2015 (see above) and also with his cognitive struggles over the polar night.

Table 5.5

Albert Felt More Confused than the Explorers and his Case Controls.

POMS: Confusion-Bewilderment

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
Equinox	9	3.00	2.12	13	4.48	.001	99.90	99.08 to 100.00	4.72	2.36 to 7.07
Winter Isolation	9	4.22	1.56	12	4.73	.001	99.93	99.38 to 100.00	4.99	2.50 to 7.46
Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
Summer	9	2.89	2.32	8	2.09	.035	96.50	82.69 to 99.97	2.20	0.94 to 3.43
Season	Case Controls			Albert	Significance Test		Estimated percentage of the Case Controls obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	CI
After Arrival	6	2.83	1.72	9	3.32	.010	98.95	90.15 to 100.00	3.59	1.29 to 5.87
Equinox	6	2.83	1.72	13	5.47	.001	99.86	98.94 to 100.00	5.91	2.30 to 9.55
Winter Isolation	6	3.17	1.72	12	4.75	.003	99.75	97.56 to 100.00	5.13	1.97 to 8.31
Summer	6	3.00	1.67	8	2.77	.020	98.04	84.57 to 100.00	2.99	1.02 to 4.95

In comparison to his Case Controls, he was more confused After Arrival, at Equinox, during Winter Isolation and in the Summer. While his suggestion of having a "big hurricane" in his head related to his young age in comparison to his fellow Explorers, his increased Confusion in comparison to peer-aged Case Controls requires a different explanation. Perhaps the combination of being so young and being at the station is what elevated Albert's levels of Confusion in comparison to both groups.

Only 2% of Explorers reported such low levels of Vigor as Albert in Winter, while in Summer Albert reported more Vigor than 97%. His lack of Vigor in Winter is consistent with Albert's self-description above while the exhaustion of the Explorers in their final Summer is consistent with their accounts from that month (see Section 4.4.4).

Table 5.6

Albert's Levels of Vigor Differed From the Explorers.

POMS: Vigor

Season	Explorers			Albert	Significance Test		Estimated percentage of the control population obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	CI
Winter Isolation	9	8.67	1.87	4	-2.37	.022	2.27	0.01 to 13.22	-2.50	-3.85 to -1.12
Summer	9	6.56	4.16	16	2.15	.032	96.83	83.69 to 99.98	2.27	0.98 to 3.52

However, no differences between Albert and the Case Controls emerged. This suggests that while Albert was unusually low in his Vigor compared to the other Explorers, these low levels of Winter Vigor were to be expected in someone of his background.

The TMD indicates a person's overall mood disturbance as a deviation from feeling vigorous. Here, Albert reported more disturbances than nearly 100% of the Explorers during the Equinox and Winter Isolation.

Table 5.7

Albert's TMD in Comparison to the Explorers and Case Controls.

POMS: TMD

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
Equinox	9	8.7	20.33	60	2.39	.021	97.82	87.11 to 99.99	2.53	1.13 to 3.89
Winter Isolation	9	7.5	10.99	66	5.05	.001	99.95	99.64 to 100.00	5.32	2.68 to 7.95
Season	**Case Controls**			**Albert**	**Significance Test**		**Estimated percentage of the Case Controls obtaining a lower score than Albert**		**Estimated effect size (z_{cc})**	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
After Arrival	6	5.33	9.09	43	3.84	.006	99.39	93.81 to 100.00	4.14	1.54 to 6.75
Equinox	6	5.33	9.09	60	5.57	.001	99.87	99.05 to 100.00	6.01	2.35 to 9.71
Winter Isolation	6	5.83	8.75	66	6.37	<.001	99.93	99.66 to 100.00	6.87	2.71 to 11.08

He also reported more disturbances than approximately 100% of the Case Controls After Arrival, at Equinox and during Winter Isolation. This suggests that his unusually high disturbance After Arrival was similar to that of the other Explorers, and hence related to his newly begun polar expedition. Over time, his moods did not settle down like the other Explorers' moods did.

5.3.5 Albert's Mental Health

The above analyses quantify Albert's claims of feeling desperate, confused, tense and anxious. While the SCL-90-R also contains sub-scales to measure these experiences, it would be redundant to re-run these analyses. Instead, Obsessive Compulsion was chosen from the SCL-90-R. Obsessive Compulsion here also includes the cognitive performance deficits (Derogatis, 1994, p. 9) which Albert experienced. In our follow-up meetings after his Winter interview, Albert also described a lack of appetite; this item was not part of any of the sub-scales and was thus tested individually. In addition, the three global indices were tested to attest to Albert's symptoms being more in frequency (PST) and stronger in their intensity (PSDI, GSI) than his peers'.

Altogether, Albert had more cognitive complaints than approximately 99% of the Explorers After Arrival, at Equinox and during the Winter Isolation.

Table 5.8

Albert Experienced More Cognitive Deficits Than the Explorers.

SCL: Obsessive Compulsion

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
After Arrival	9	1.67	2.06	18	7.52	<. 000	99.99	99.99 to 100.00	7.93	4.07 to 11.79
Equinox	9	4.44	5.43	21	2.89	.010	99.00	92.42 to 100.00	3.05	1.43 to 4.64
Winter Isolation	9	4.33	3.81	23	4.65	.001	99.92	99.30 to 100.00	4.90	2.46 to 7.33

There were no differences between Albert and his Case Controls in this domain, so it is possible that the mission affected his cognition more than that of the other Explorers because of his younger age and high education compared to his fellow Explorers.

Table 5.9

Albert's Appetite During Winter Isolation in Comparison to the Explorers.

Poor Appetite

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size	
	N	Mean	SD		t	p	Point	95%CI	Point	CI
Winter Isolation	9	0.11	0.33	3	8.31	<.001	100.00	100.00 to 100.00	8.76	4.51 to 13.01

This shows that Albert's appetite was poorer than approximately 100% of the Explorers. It was not possible to test his appetite in comparison to his Case Controls because *Singlims_ES.exe* requires a positive SD and the Case Controls produced a mean of 0 with an SD of 0 on this item. "0" means that in the past week, they experienced no poor appetite at all. Effectively, that also means that Albert's appetite was worse than theirs.

Albert reported more symptoms than 100% (After Arrival and Equinox) and 90% (Winter) of the Explorers. Looking at Albert's score in Table 5.10 below, it is clear that his personal amount of symptoms actually decreased over time. This suggests that he had fewer complaints. His fellow Explorers' amount of symptoms increased from After Arrival to Winter Isolation.

Table 5.10

Albert's Number of Symptoms Compared to the Explorers and Case Controls.

SCL: Positive Symptom Total

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
After Arrival	9	25.67	9.11	92	6.91	<.001	99.99	99.99 to 100.00	7.28	3.73 to 10.83
Equinox	9	19.33	16.57	80	3.47	.004	99.58	96.44 to 100.00	1.90	0.76 to 3.01
Winter Isolation	9	19.89	19.41	76	2.74	.013	89.73	91.05 to 100.00	2.89	1.34 to 4.41
Season	Case Controls			Albert	Significance Test		Estimated percentage of the Case Controls obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
After Arrival	6	17.83	12.75	92	5.39	.001	99.85	98.82 to 100.00	5.82	2.26 to 9.40
Equinox	6	17.33	13.49	80	4.30	.004	99.61	96.07 to 100.00	4.65	1.76 to 7.54
Winter Isolation	6	17.50	13.23	76	4.09	.005	99.53	95.16 to 100.00	4.42	1.66 to 7.19

Throughout the same measuring points, Albert continued to report more symptoms than 100% of his Case Controls.

In addition to an increased amount of symptoms, Albert described his symptoms as more severe: he rated them higher than the other Explorers at Equinox and during Winter Isolation. While initially, Albert's and the Explorers' symptom severity was similar, theirs remained stable while his increased.

Table 5.11

The Severity of Albert's Symptoms Compared to the Explorers and Case Controls.

SCL: Global Severity Index

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
Equinox	9	0.29	0.27	1.98	5.94	<.001	99.98	99.93 to 100.00	6.26	3.19 to 9.33
Winter Isolation	9	0.29	0.30	2.42	6.74	<.001	99.99	99.99 to 100.00	7.1	3.64 to 10.57
Season	**Case Controls**			**Albert**	**Significance Test**		**Estimated percentage of the Case Controls obtaining a lower score than Albert**		**Estimated effect size (z_{cc})**	
	N	Mean	SD		t	p	Point	95%CI	Point	CI
After Arrival	6	0.26	0.25	1.44	4.37	.004	99.64	96.33 to 100.00	4.72	1.79 to 7.66
Equinox	6	0.26	0.25	1.98	6.37	.001	99.93	99.67 to 100.00	6.88	2.71 to 11.09
Winter Isolation	6	0.26	0.25	2.42	8.00	<.001	99.98	99.97 to 100.00	8.64	3.45 to 13.90

The Case Controls' symptom severity did not vary across time at all, while Albert's kept increasing. It was higher than the Controls' at the beginning of his mission but not higher than the Explorers which suggests that the mission's beginning led to an increased symptom severity.

The PSDI followed a slightly different pattern: Albert's intensity on this measure was higher than all of the Explorers' at Equinox and during Winter Isolation.

Table 5.12

Albert's PSDI in Comparison to the Explorers and Case Controls.

SCL: Positive Symptom Distress Index

Season	Explorers			Albert	Significance Test		Estimated percentage of the Explorers obtaining a lower score than Albert		Estimated effect size (z_{cc})	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
Equinox	9	1.11	0.47	2.23	2.26	.027	97.32	85.29 to 99.99	2.38	1.05 to 3.69
Winter Isolation	9	1.16	0.53	2.87	3.06	.008	99.22	93.75 to 100.00	3.23	1.54 to 4.90
Season	**Case Controls**			**Albert**	**Significance Test**		**Estimated percentage of the Case Controls obtaining a lower score than Albert**		**Estimated effect size (z_{cc})**	
	N	Mean	SD		t	p	Point	95%CI	Point	95%CI
Winter Isolation	6	1.05	0.55	2.87	3.06	.013	98.60	87.77 to 100.00	3.31	1.16 to 5.44

However, only his Winter Isolation intensity differed from the Case Controls. Overall, this shows that Albert's mental health problems were more in number and stronger in intensity than those of his peers at the station and matched controls.

The mood and mental health assessments above serve to substantiate that Albert felt worse than the other Explorers and than could be expected of someone with a similar background. This means that his evacuation was justified because his emotional state improved upon his return home on all measures except POMS Confusion. His overall symptoms subsided in quantity and intensity.

5.3.6 Albert's Cognition

In January 2016, Albert's concerns about his declined cognitive faculties concentrated on his lack of new ideas but also on his inability to retain verbally acquired information. My behavioural observations supported his own experiences see the extract from my diary quoted above. This warranted testing whether Albert's cognitive performance had worsened in comparison to himself in September 2015, rather than comparing his performance to that of the remaining Explorers and Case Controls. However, Crawford and Garthwaite's (2005) methods did not yield any dissociations over time. This shows how greatly any individual's experience of themselves in an Arctic environment can differ from a quantitative measure of their experience: while Albert despaired over his inability to focus and remember things, and worried whether he would ever be able to do so again, his tests showed that his cognition remained unaffected.

5.4 Conclusions About Albert's Experiences

Despite case studies of mental health problems over the polar night and ICE missions dating back to the *Belgica* expedition of 1898 (Palinkas, Gunderson, Johnson, et al., 2000), detailed reporting on clinical and cognitive assessments has been entirely absent from the literature. So have qualitative investigations of their lived experiences over the course of their mission. This chapter, including its application of Crawford and Garthwaite's (2002, 2005) techniques on mood and mental health variables poses an original contribution to polar psychology. For this chapter, the application of a mixed-methods approach was most valuable because the qualitative data informed the analysis of the quantitative data in line with the suggestions of Creswell and Plano (2011, p. 71). The analyses of Albert's lived experiences at the station thus makes an original contribution to polar psychology.

Altogether, Albert's personal experience of the station was characterised by a lack of family life as well as a lack of sensory and intellectual input. Over time, this led to a loss of meaningfulness and joy in his station life. He struggled to derive happiness from completing his duties in the way his peers did, and he could not find a source of happiness for himself that was rooted at the station. This was due to his feeling of captivity within the schedules and hierarchy of the station. What kept him going was the outlook on life after the station, focusing on his research and research career; as well as maintaining contact with his family and partner.

Albert's mood and mental health results show that he was more unhappy than the other Explorers or his Case Controls. Upon Albert's return home, his symptom frequency and intensity improved to their levels. This suggests that while the other Explorers eventually settled into the station as their new home, Albert could not quite feel at home there because he was far removed from the people and life he loved. He also struggled to recognise his own mind and behaviours at the station in winter, which intensified his dissociation from home and happiness.

This relates to two research questions: how do these experiences fluctuate in the quantitative measures, and what makes a good winter candidate?

Albert's experience shows that polar experiences are highly individual and that while one or several individuals may thrive in an ICE setting, others may find it highly detrimental. This warns future behavioural researchers not to generalise from their quantitative group-based analyses too quickly, much like Wood et al. (1999) suggested. And while Albert was a hard-working, popular team member who was missed by the others after he left (see Section 4.4.3), it is clear that an ideal winter candidate would not need to be evacuated due to his genuine emotional suffering. An ideal winter candidate would thrive on their polar experience. Additionally, his and the other Explorers' interview material makes it very clear that interacting with other human beings is the most complicated and possibly dangerous aspect of a polar expedition (*The Good Group, The Janitor* above; *People are Problematic, This Family is Fragile, Privacy is Paramount* and *People Annoy Me* in Sections 4.4.1 and 4.4.2). This leads to the next chapter's research question: what makes a good polar winter candidate?

6. What Makes a Good Winter Candidate?

This chapter aims to answer two questions:

1. Can personality traits predict well-being in winter? If so, how?
2. Which traits and behaviours make a desirable wintering candidate?

For the purpose of these questions, "well-being" is taken as the individual aspects of the POMS and the SCL rather than their combined indices (the TMD, the GSI, the PST and the PSDI). This is to determine whether personality influences different aspects of well-being in different manners. To answer these questions, Albert's data were included throughout this chapter. Each analysis concludes with a remark on whether or not the presented results were maintained when Albert's data were excluded. JASP files containing the significant results with and without Albert's data can be obtained as an online appendix here: https://osf.io/n894w/

6.1 Descriptive Statistics

The previous chapter's descriptive statistics excluded Albert's data, so here, the personality traits alongside the mental health and mood data from the winter isolation are presented again including his data.

Table 6.1

The Explorers' Personality Traits Including Albert.

Personality Trait	Mean (SD)
Openness to Experience	28.90 (5.63)
Conscientiousness	30.60 (6.29)

Personality Trait	Mean (SD)
Extraversion	29.90 (3.14)
Agreeableness	31.70 (6.34)
Neuroticism	18.10 (7.61)

The previous chapter strongly suggested that Albert was less extraverted and higher in neuroticism than his fellow Explorers.

Table 6.2

The Descriptive Statistics of Winter Mood.

Winter Mood	Mean (SD)
Anger	3.50 (3.60)
Depression	3.40 (4.95)
Tension	4.20 (4.42)
Confusion	5.00 (2.87)
Vigor	8.20 (2.30)

Albert also struggled with more mood issues, hence the increased means and SD in Table 6.2 (compared to Table 3.3).

Table 6.3

The Descriptive Statistics of Winter Mental Health.

Winter Mental Health	Mean (SD)
Somatization	6.90 (10.99)
Obsessive Compulsive Behaviour	6.20 (6.91)
Interpersonal Sensitivity	5.00 (7.18)
Depression	7.30 (1.60)
Anxiety	5.20 (10.14)
Hostility	2.20 (3.77)
Phobic Anxiety	1.70 (3.47)

Winter Mental Health	Mean (SD)
Paranoid Ideation	2.30 (3.43)
Psychoticism	3.10 (6.24)

With Albert's data included, there was no reason to assume that the assumption of normality would be met in the following models. However, the linear regression models did not serve to detect an effect or an effect size in this part of the study. The BFHT was employed to detect the best possible models and the strongest effects; this was followed up by linear regression to obtain the coefficients of the models and effects.

Popularity Ratings

Here, each Explorer listed the top five of his/her colleagues who fulfilled the criterion in question, e.g. the top five people who were calm in emergencies. To calculate the rankings, the person who was listed number one was awarded five points, the person who was listed as second was awarded four points until the person who had been placed fifth was awarded only one point. Explorers who were not listed for this particular criterion were awarded zero points. Then, the average of these rankings were calculated. So, if hypothetically, an Explorer had been rated number one for calm in emergencies by every single one of the others, his/her average would be 5.00. These rankings therefore reflect how much of the quality in question other people saw in any given individual, they do not reflect how important the quality in itself was considered.

Table 6.4

The Average, SD, and Maxima of the Different Qualities.

Quality	Mean (SD)	max. reached
Calm in Emergencies	1.07 (1.27)	3.50
Friendliest	1.12 (1.29)	3.40
Closest Friend	0.98 (0.86)	2.50
Leadership	0.52 (0.76)	2.30
Hardest Working	1.25 (1.30)	3.70
Hardest Job	1.09 (1.36)	3.40
Job Knowledge	1.20 (1.11)	3.50
Winter Again	1.07 (1.05)	3.00

"Winter Again" means whether any given Explorer was chosen by their colleagues for a hypothetical next winter expedition. Each Explorer had to list the five people they would take on another winter mission in descending order. The minimum score for all qualities was always zero because there were always individuals who had not been listed as top five by anybody for a specific quality. On the other hand, the higher the maximum score, the more Explorers had agreed on a particular person's quality.

6.2: Inferential Statistics: Can Personality Predict Well-Being in Winter?

These data were approached differently than the mission time data in the previous chapter because in these regression analyses the predictors Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism competed with one another. The BFHT in JASP was run first and based on which traits the results suggested should be included, a single classical linear regression model was built to obtain the coefficients (refer back to Section 2.8). For the BFHT, the best model or – if there is no single best model – best models will be reported; in addition to the *null hypothesis model (null model)*. The tables which reporting on the classical regression will contain the *unstandardised beta coefficients (B*), their *standard error (SE(B))*, the *standardised beta coefficients (β)*, the t-values and the p-values. In case of multiple regression models, there will also be the tolerance, the *variance inflation factor (VIF)* and the Eigenvalues to assess the models' fit. Bayesian models were only reported if they explained the data at least ten times better than the null model.

6.2.1 Predicting Winter Mood

All POMS DV except for Fatigue were successfully predicted by personality traits.

Confusion

The Bayesian linear regression suggested that Neuroticism provided the best explanation of Winter Confusion (P(M)=.031, P(MIdata)=0.472, BF_M=27.68). It explained my data 1328 times better than the null model (P(M)=.031, P(M|data)=3.5552E-04, BF_M=0.01, BF_{01}=1327.98, error%=3.2773E-05). The analysis of effects yielded that only Neuroticism should be included ($BF_{Inclusion}$=103.42).

The classical model yielded a significant effect of Neuroticism on Winter Confusion ($F_{(1,9)}$=101.1, R^2=.927, p<.001, 95%CI[0.28l0.46], VS-MPR=3858.00).

Table 6.5

The Coefficients for Neuroticism Predicting Confusion.

Source	B	SE (B)	β	t	p
(intercept)	-1.57	0.70		-2.23	.056
Neuroticism	0.36	0.04	0.963	10.06	<.001

There was a very strong correlation between the two variables (β=.963): With each one point in Neuroticism, Winter Confusion increased by 0.36 (the unstandardised beta coefficient B in Table 4.5). Figure 6.1 shows all traits in relation to Winter Confusion and the trend line for the above regression.

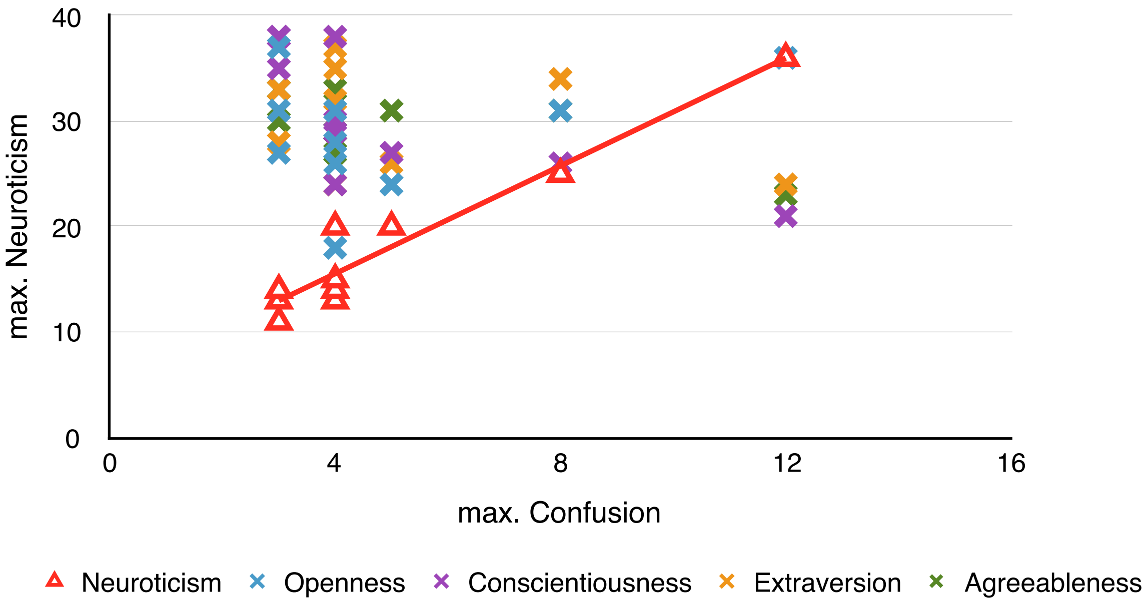

Figure 6.1: Explorers with Higher Neuroticism Experienced More Confusion in Winter.

Neuroticism explained the differences in Winter Confusion 1124 times better than the null hypothesis and was responsible for 92.7% of Winter Confusion's variation. This effect had a chance lower than 0.01% of occurring if the null hypothesis were true and was 3858 times more likely to occur under the assumption that Neuroticism predicts Winter Confusion.

The Neuroticism model held even when Albert's data were removed (P(M)=0.031, P(M|data)=0.215, BF_M=8.46, BF_{01}=1.000) and explained the results 16 times better than the null model without Albert (P(M)=0.031, P(M|data)=0.013, BF_M=0.41, BF_{01}=16.49, %error=6.946e-4). These findings combined provide very strong evidence for the hypothesis that more neurotic Explorers felt more confused during the winter isolation.

Vigor

The Bayesian linear regression yielded four models which were similarly good at predicting Winter Vigor (Table 6.6).

Table 6.6

Agreeableness and Neuroticism Were the Best Predictors of Winter Vigor.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Agreeableness + Neuroticism	0.031	0.243	9.97	1.00	
Conscientiousness + Agreeableness	0.031	0.164	6.08	1.48	1.894E-04
Conscientiousness + Agreeableness + Neuroticism	0.031	0.116	4.05	2.11	1.072E-04
Openness + Agreeableness + Neuroticism	0.031	0.086	2.89	2.85	9.221E-04
Null model	0.031	0.001	0.04	191.55	3.554E-05

Table 6.6 suggests that the best model is Agreeableness + Neuroticism, however it barely outperforms the other personality models. Agreeableness + Neuroticism explained my data 191 times better than the null model. However, the only effect to be included in the prediction of Winter Vigor was Agreeableness (BF_{incl}=41.80). Neuroticism was not recommended (BF_{incl}=1.83). This is somewhat surprising, given that the best model was Agreeableness + Neuroticism in Table 4.6; this model explained my data six times better than Agreeableness on its own (P(M)=.031, P(M|data)=0.035, BF_M=1.14, BF_{01}=6.88). Possibly, these findings indicate a mediation of Neuroticism's influence on Vigor by Agreeableness: the people to feel the most excitement at the station are those who worry less, which are also the people who get along more easily with others. The classical model was thus a multiple linear regression built on Agreeableness + Neuroticism.

This model confirmed a significant effect of Agreeableness and Neuroticism on Winter Vigor ($F_{(2,9)}$=43.22, R^2=.925, p<.001, VS-MPR=352.4, Durbin-Watson statistic=2.22). The individual coefficients are in Table 6.7 below.

Table 6.7

The Multiple Regression of Agreeableness and Neuroticism on Winter Vigor.

Source	B	SE (B)	β	t	p	Tolerance	VIF	Eigenvalue
(intercept)	2.41	1.63		1.48	0.182			2.86
Agreeableness	0.26	0.04	0.711	6.38	<.001	0.861	1.61	0.62
Neuroticism	-0.13	0.03	-0.435	-3.90	0.006	0.861	1.61	0.36

These coefficients show that for each one point in Agreeableness, Winter Vigor increased by 0.26 (p<.001, 95%CI[0.16|0.35]), while for each point in

Neuroticism it decreased by 0.13 ($p=.006$, 95%CI[-0.21|-0.05]). Agreeableness was the more influential of the two ($\beta=.711$); Figure 5.2 below demonstrates the effect of both traits.

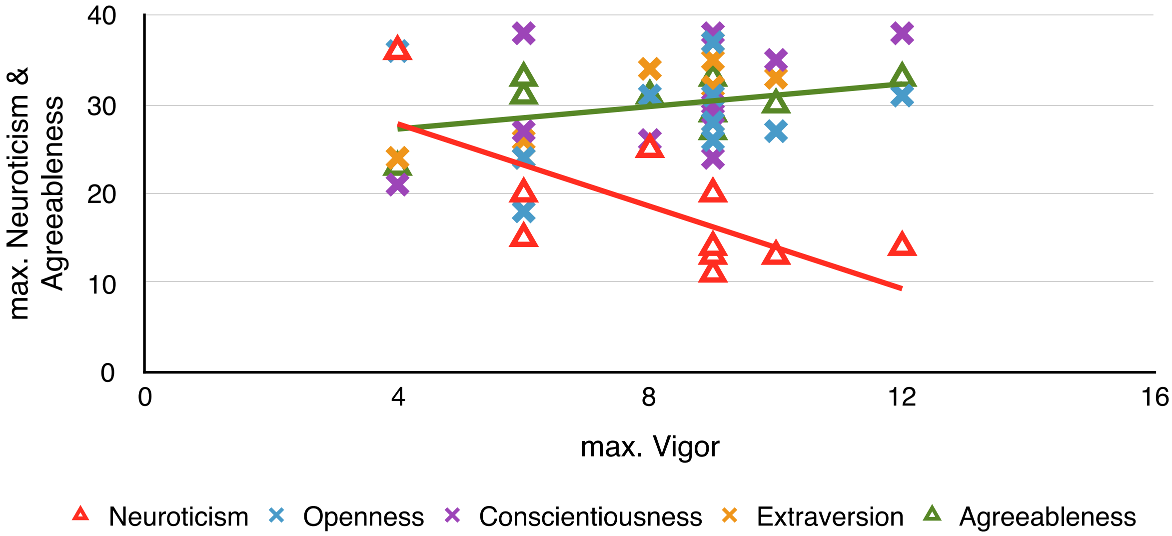

Figure 6.2: Higher Neuroticism and Lower Agreeableness Predicted Lower Winter Vigor.

Neuroticism and Agreeableness explained 92.5% of Winter Vigor's variation, under the null hypothesis this finding had a chance of less than 0.01% of occurring. Neuroticism and Agreeableness together explained my data 191 times better than the null hypothesis.

This model did not hold when Albert's data were excluded. Without his data, Openness + Conscientiousness + Extraversion + Agreeableness was the best model ($P(M)=0.031$, $P(M|data)=0.235$, $BF_M=9.53$, $BF_{01}=1.000$); it explained the data almost 50 times better than the null model ($P(M)=0.031$, $P(M|data)=0.005$, $BF_M=0.147$, $BF_{01}=49.82$, error%=0.005).

Anger-Hostility

Here, two models performed similarly: Neuroticism and Openness + Neuroticism.

Table 6.8

Neuroticism was the Best Predictor of Winter Anger-Hostility.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.315	14.28	1.00	
Openness + Neuroticism	0.031	0.200	7.57	1.61	0.005
Null model	0.031	9.085E-04	0.03	347.15	0.005

Of the two, the evidence in favour of Neuroticism would be classified as "strong" and as "moderate" for Openness + Neuroticism (Wagenmakers, Marsman et al., 2017). Neuroticism explained my data approximately 350 times better than the null model. The analysis of effects supported only the inclusion of Neuroticism (BF_{incl}=25.58).

The classical linear regression confirmed a significant effect of Neuroticism on Winter Anger-Hostility ($F_{(1,8)}$=65.24, R^2=.891, p<.001, 95%CI[0.33|0.57], VS-MPR=893.1). The Durbin-Watson statistic (2.69) showed that there was little or no autocorrelation in this model.

Table 6.9

The Coefficients of Neuroticism Predicting Winter Anger-Hostility.

Source	B	SE (B)	β	t	p
(intercept)	-4.67	1.20		-3.90	0.006
Neuroticism	0.45	0.06	0.943	7.51	<.001

For each one point increase in Neuroticism, Winter-Hostility increased by 0.45 points, this was a strong correlation (β=0.944). See Figure 5.3.

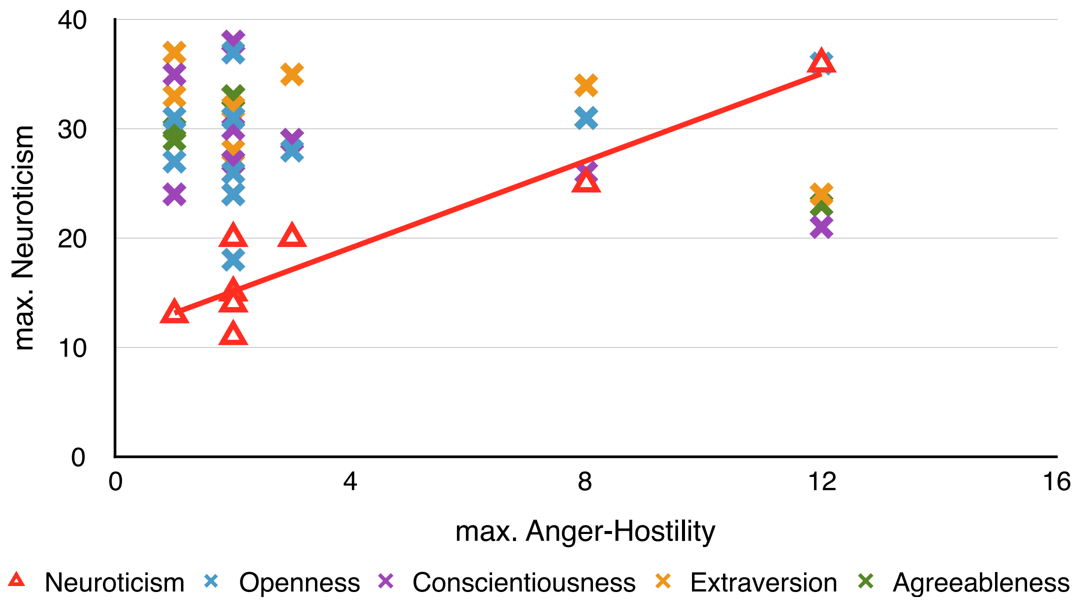

Figure 6.3: Explorers Who Were Higher in Neuroticism Reported More Anger-Hostility in Winter.

Neuroticism explained 89.1% of variance in Winter Anger-Hostility, these data are 347 times more likely under this effect than the null hypothesis. When Albert's data were excluded, no personality-based prediction of Anger-Hostility was successful. This suggests that this effect predominantly applies to high in neuroticism and/or angry-hostile Explorers but not to those who score lower on these scales.

Tension

Here, there were three similarly good models: Neuroticism, Neuroticism + Conscientiousness, and Neuroticism + Agreeableness. Neuroticism was the best model, see Table 6.10 below.

Table 6.10

Neuroticism was the Best Predictor of Winter Tension.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.240	9.79	1.00	
Neuroticism + Conscientiousness	0.031	0.123	4.37	1.94	9.277E-04
Neuroticism + Agreeableness	0.031	0.119	4.18	2.02	9.051E-04
Null model	0.031	0.002	0.07	106.56	4.257E-04

Neuroticism on its own was the best predictor, it explained the Explorers' data 106 times better than the null model. Neuroticism was the only effect to be included (BF_{incl}=29.80), according to the analysis of effects.

Based on this, the classical linear regression was run. It confirmed that Neuroticism predicts Winter Tension ($F_{(1,9)}$=43.18, R^2=.844, $p<.001$, 95%CI[0.35|0.72], VS-MPR=243.6). The Durbin-Watson statistic (1.48) suggested that there was little or no autocorrelation in this model.

Table 6.11

The Coefficients for Neuroticism Predicting Winter Tension.

Source	B	SE (B)	β	t	p
(intercept)	-5.45	1.58		-3.45	.009
Neuroticism	0.53	0.08	0.919	6.57	<.001

For each one point increase in Neuroticism, Winter Tension increased by 0.53, this relationship was very strong as can be seen by the steepness of the incline in Figure 5.4 below (β=.919).

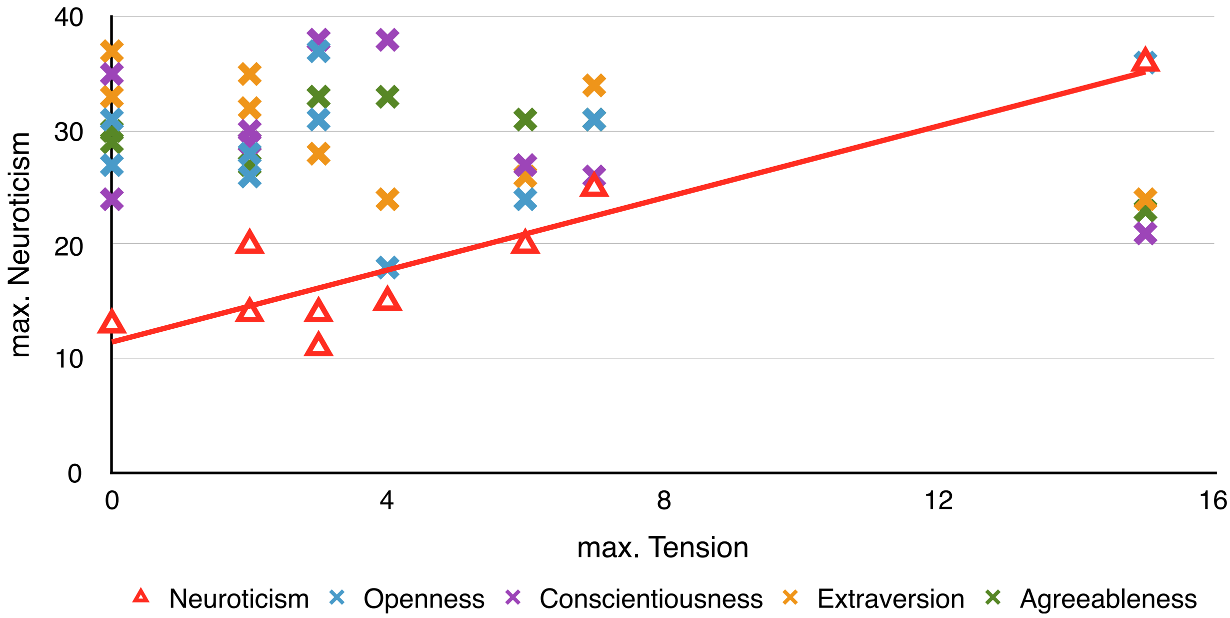

Figure 6.4: Explorers Who Were Higher in Neuroticism Reported More Winter Tension.

This suggests that the higher in neuroticism an Explorer was, the more tense they would feel in winter. When Albert's data were excluded, this model did not hold. The best-performing model in this case was Extraversion + Neuroticism (P(M)=0.031, P(M|data)=0.119, BFM=4.20, BF01=1.00) which outperformed the null model by a factor of five (P(M)=0.031, P(M|data)=0.024, BFM=0.77, BF01=4.90, error%=0.001).

POMS Depression

Neuroticism was the best predictor of Winter Depression.

Table 6.12

Neuroticism Predicted Winter Depression (POMS) Best.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.338	15.85	1.00	
Null model	0.031	0.002	0.05	210.98	4.911E-04

The Neuroticism model outperformed the null model; it explained my data 211 times better. Neuroticism was also the only effect whose inclusion was supported (P(incl)=0.500, P(incl|data)=0.970, BFincl=31.98).

Based on this, the classical linear regression model was built on just Neuroticism. This model yielded a significant impact of Neuroticism on Winter Depression ($F_{(1,9)}$=55.03, R^2=.873, p<.001, VS-MPR=517.3).

Table 6.13

The Coefficients of Neuroticism Predicting Winter Depression (POMS).

Source	B	SE (B)	β	t	p
(intercept)	-7.06	1.60		-4.76	0.001
Neuroticism	0.61	0.08	0.934	7.42	<.001

For each point increase in Neuroticism, Winter Depression increased by 0.61 points. This was a strong correlation (β=.934).

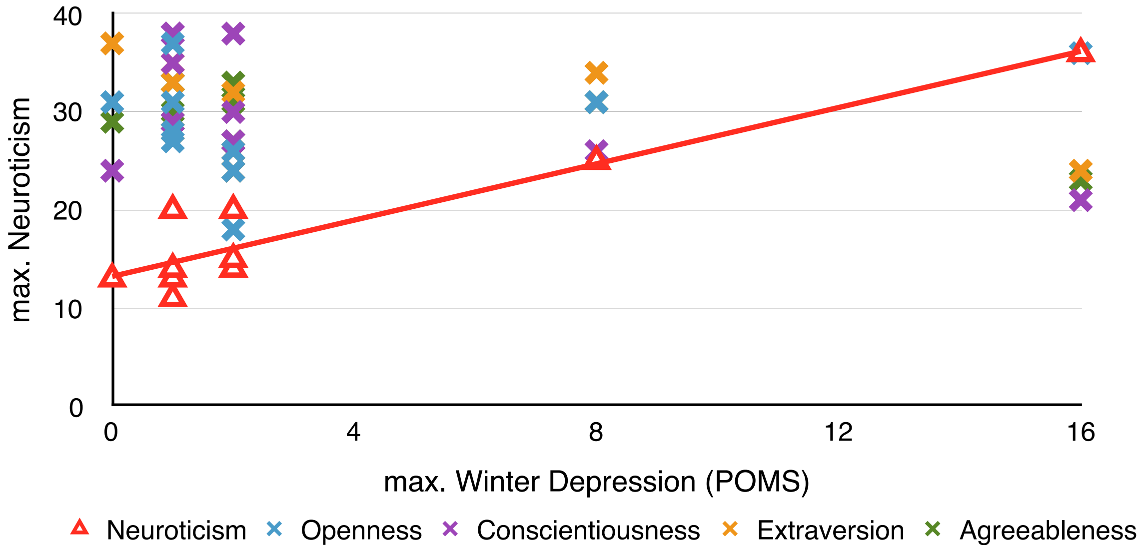

Figure 6.5: Explorers who Were Higher in Neuroticism Felt More Depressed in Winter.

Explorers who were high in Neuroticism felt more depressed in winter. This model held when Albert's data were removed (P(M)=0.031, P(M|data)=0.139, BF_M=5.02, BF_{01}=1.00) but only explained the data about four times better than the null model (P(M)=0.031, P(M|data)=0.034, BF_M=1.08, BF_{01}=4.13, error%=7.320e-4).

6.2.2 Predicting Winter Mental Health

Psychoticism

In Winter, Neuroticism + Openness were the best predictors of Psychoticism., although Neuroticism and Neuroticism + Agreeableness + Openness were of similar predictive power.

Table 6.14

The Best Bayesian Regression Model for Psychoticism was Neuroticism + Openness.

Model	P(M)	P(M| data)	BF_M	BF_{01}	error%
Neuroticism + Openness	0.031	0.260	10.91	1.00	
Neuroticism	0.031	0.163	6.06	1.59	5.009E-04
Neuroticism + Agreeableness + Openness	0.031	0.103	3.54	2.54	0.002
Null model	0.031	0.002	0.06	133.55	1.527E-04

Neuroticism + Openness predicted Winter Psychoticism approximately 134 times better than the null model. Nevertheless, Neuroticism was the only effect whose inclusion was supported (P(incl)=0.500m P(incl\|data)= 0.958, BF_{incl}=22.82). In the classical model, Neuroticism was a significant predictor of Winter Psychoticism ($F_{(2,9)}$=37.6, R^2=.915, p<.001, VS-MPR=236.8).

Table 6.15

The Coefficients for Neuroticism + Openness Predicting Winter Psychoticism.

Source	B	SE (B)	β	t	p	Tolerance	VIF	Eigenvalue
(intercept)	-18.83	3.66		-5.15	0.001			2.9
Neuroticism	0.68	0.09	0.827	7.19	<.001	0.92	1.08	0.09
Openness	0.33	0.128	0.301	2.61	0.035	0.92	1.08	0.01

For each point increase in Neuroticism, Winter Psychoticism increased by 0.68 points (p<.001, 95%CI[0.45l0.90], VS-MPR=238.14); for each point in Openness it increased by 0.33 points (p=.035, 95%CI[0.32l0.653], VS-

MPR=3.16). The correlation with Neuroticism (β=0.827) was strong while the one with Openness (β=0.301) was moderate.

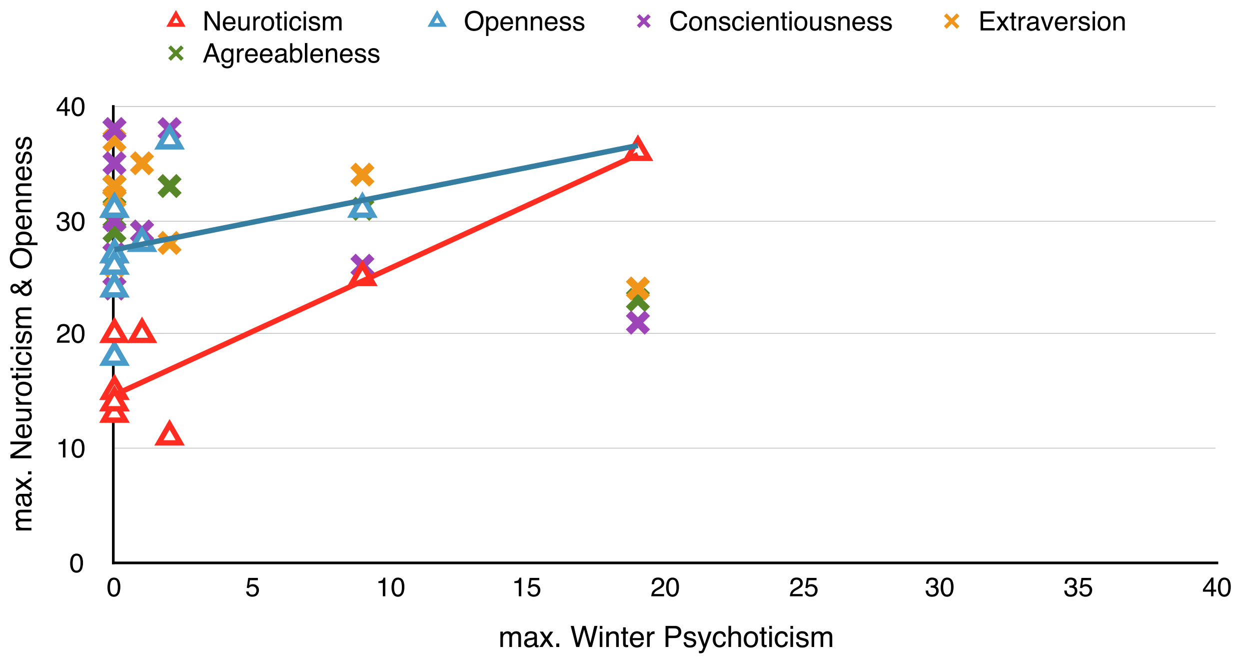

Figure 6.6: Explorers Who Were Higher in Neuroticism and More Open Needed More Privacy.

The higher in neuroticism and openness an Explorer was, the more likely they were to need increased privacy in winter. This model only received moderate support when Albert's data were removed (P(M)=0.031, P(M|)=0.106, BFM=3.67, BF01=1.00) and was not better than the null model.

Interpersonal Sensitivity

Neuroticism was the best predictor of Sensitivity, but it was not substantially better than Neuroticism + Openness or Neuroticism + Extraversion.

Table 6.16

Neuroticism was the Best Model for Interpersonal Sensitivity.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.178	6.70	1.00	
Neuroticism + Openness	0.031	0.139	5.01	1.28	0.002
Neuroticism + Extraversion	0.031	0.064	2.12	2.76	0.001
Null model	0.031	0.009	0.237	20.38	7.754E-04

Neuroticism **explained my data 20 times better than the** null model**. There** was only moderate evidence in favour of the inclusion of Neuroticism (P(incl)=0.500, P(incl|data)=0.846, BF_{incl}=5.48).

Neuroticism significantly predicted Interpersonal Sensitivity in Winter in the classical linear regression model ($F_{(1,9)}$=22.4, R^2=.737, p=.001, VS-MPR=38.19).

Table 6.17

The Coefficients of Neuroticism Predicting Interpersonal Sensitivity.

Source	B	SE (B)	β	t	p
(intercept)	-9.66	3.34		-2.90	.020
Neuroticism	0.82	0.17	0.858	4.732	.001

This strong correlation showed that for each point in Neuroticism, Interpersonal Sensitivity increased by 0.82 points in Winter (β=.858).

While Neuroticism explained 73.7% of variation in Interpersonal Sensitivity This model did not hold up at all when Albert's data were excluded (P(M)=0.031, P(M|data)=0.075, BF_M=2.51, BF_{01}=1.00) and did not outperform the null model. This means that the effect of Neuroticism on

Interpersonal Sensitivity is likely to be most pronounced in those who score unusually high on one or both of these scales. As personality's relationship with Depression has already been established above, the SCL-90-R's Depression scale is omitted here.

Obsessive Compulsion

Neuroticism was the best predictor of Obsessive Compulsion in Winter, but Neuroticism + Openness, Neuroticism + Extraversion, and Neuroticism + Agreeableness were similarly good.

Table 6.18

Neuroticism Predicted Obsessive Compulsion Best.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.167	6.23	1.00	
Neuroticism + Openness	0.031	0.105	3.63	1.60	0.002
Neuroticism + Extraversion	0.031	0.074	2.48	2.26	0.002
Neuroticism + Agreeableness	0.031	0.058	1.91	2.88	0.001
Null model	0.031	0.008	0.25	21.03	7.173E-04

Neuroticism had a moderate effect on Obsessive Compulsion in winter (BF_M=6.23) and explained these data 21 times better than the null model (BF_{01}=21.03). There was moderate support for Neuroticism's inclusion (P(incl)=0.500, P(incl|data)=4.49, BF_{incl}=4.49).

Based on this, the classical linear regression was built. It yielded a significant effect of Neuroticism on Obsessive Compulsion in winter ($F_{(1,9)}$=22.71, R^2=.740, p=.001, VS-MPR=39.95). The Durbin-Watson statistic (2.17) suggested that there was no problem with autocorrelation.

Table 6.19

The Coefficients of Neuroticism's Effect on Obsessive Compulsion.

Source	B	SE (B)	β	t	p
(intercept)	-7.94	3.19		-2.49	.038
Neuroticism	0.78	0.16	0.860	4.77	.001

These coefficients show a strong correlation between Neuroticism and Obsessive Compulsion (β=.860): for each point in Neuroticism, Obsessive Compulsion increased by 0.78 points.

Altogether, this effect had a 0.01% chance of occurring under the null hypothesis; it was 40 times more likely to occur under the alternative hypothesis. Neuroticism explained 74% of the variation in Obsessive Compulsion, it was the best predictor of the personality traits. These findings did not hold when Albert's data were removed. This implies that in extreme cases, people with high levels of neuroticism are more prone to obsessive-compulsive behaviours (see Albert's personality in comparison to his peers in Table 5.3).

Anxiety

There were several good models which predicted Anxiety in winter, but Neuroticism was the best.

Table 6.20

The Best Bayesian Models to Predict Anxiety in Winter.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.191	7.30	1.00	
Neuroticism + Extraversion	0.031	0.081	2.75	2.34	0.002
Neuroticism + Agreeableness	0.031	0.078	2.63	2.44	0.002
Neuroticism + Openness	0.031	0.069	2.29	2.77	0.002
Neuroticism + Conscientiousness	0.031	0.066	2.21	2.87	0.002
Neuroticism + Extraversion + Conscientiousness	0.031	0.066	2.19	2.89	0.003
Null model	0.031	0.006	0.20	30.45	1.448E-04

There was moderate support for Neuroticism (BF_M=7.30) and anecdotal support for the other personality models (BF_M<3.00). Neuroticism explained Anxiety 30 times better than the null model (BF_{01}=30.45). There was moderate support to include Neuroticism in such a model (P(incl)=0.500, P(incl|data)=0.860, BF_{incl}=6.14).

Consequently, the classical model incorporated only Neuroticism. Neuroticism was a significant predictor of Anxiety in winter ($F_{(1,9)}$=26.59, R^2=.769, p<.001, 95%CI[0.65|.69], VS-MPR=60.17). The Durbin-Watson statistic suggested little or no autocorrelation (1.79).

Table 6.21

The Coefficients of Neuroticism Predicting Anxiety in Winter.

Source	B	SE (B)	β	t	p
(intercept)	-15.95	4.42		-3.61	.007
Neuroticism	1.17	0.23	0.877	5.16	<.001

There was a strong correlation between Neuroticism and Anxiety (β=.877): for each point in Neuroticism, Anxiety increased by 1.17 points.

All in all, Neuroticism explained 76.9% of the variance in Anxiety in winter. This finding only had a 0.01% chance of occurring under the null hypothesis and was 60 times more likely under the best possible alternative hypothesis. Neuroticism was the best possible alternative, according to the BFHT which suggested that these data were 30 times more likely under the alternative hypothesis. However, when Albert's data were removed, Neuroticism no longer influenced Anxiety. This suggests that this relationship is most apparent in cases of higher Neuroticism and/or Anxiety (see Albert's personality comparison in Table 6.x).

Hostility

Neuroticism was the best of three similarly good predictor models for Hostility during the winter.

Table 6.22

Neuroticism was the Best Predictor of Winter Hostility.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.242	9.92	1.00	
Neuroticism + Openness	0.031	0.111	3.89	2.17	4.658E-04
Neuroticism + Conscientiousness	0.031	0.106	3.66	2.29	4.557E-04
Null model	0.031	0.003	2.89	70.48	4.541E-04

Neuroticism explained the data 70 times better than the null model. It was the only one whose effect bordered on being classified as strong (BF_M=9.92);

the other personality models's effects barely crossed the threshold for moderate effects (BF_{01}>3). There was strong evidence favouring the inclusion of Neuroticism (P(incl)=0.500, P(incl|data)=0.947, BF_{incl}=17.83). In the subsequent classical model, it significantly predicted Hostility ($F_{(1,9)}$=37.05, R^2=.822, p<.001, 95%CI[0.28|0.62], VS-MPR=154.0). The Durbin-Watson statistic suggested that there was little autocorrelation (2.33).

Table 6.23

The Coefficients for Neuroticism Predicting Hostility in Winter.

Source	B	SE (B)	β	t	p
(intercept)	-5.92	1.44		-5.12	.002
Neuroticism	0.45	0.07	0.907	6.09	<.001

There was a strong correlation between the two variables (β=.907): for each point in Neuroticism, Hostility increased by 0.45 points.

Altogether, Neuroticism explained 82.2% of Hostility in winter; this finding only had a chance of 0.01% of occurring under the null hypothesis. These results would be 154 times more likely under the best alternative hypothesis. The best model according to BFHT was the Neuroticism model, it explained the data 70 times better than the null hypothesis. When Albert's data were excluded, Hostility was not explained by Neuroticism or any other personality trait.

Phobic Anxiety

Neuroticism and Neuroticism + Openness both predicted Phobic Anxiety in winter, but Neuroticism on its own was strongly supported

(BF_M=12.87) while Neuroticism + Openness was moderately supported (BF_M=8.91).

Table 6.24

The Bayesian Regression Models Predicting Phobic Anxiety.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism	0.031	0.293	12.87	1.00	
Neuroticism + Openness	0.031	0.224	8.97	1.31	3.871E-04
Null model	0.031	0.001	0.04	237.87	3.868E-04

Neuroticism outperformed the null model 238 times. There was strong support for including this effect to predict Phobic Anxiety (P(incl)=0.500, P(incl|data)=0.977, BF_{incl}=42.33).

The classical linear regression significantly predicted Phobic Anxiety using Neuroticism ($F_{(1,9)}$=57.36, R^2=.878, p<.001, 95%CI[0.30|0.58], VS-MPR=590.1).

Table 6.25

The Coefficients of Neuroticism Predicting Phobic Anxiety.

Source	B	SE (B)	β	t	p
(intercept)	-6.02	1.10		-5.49	<.001
Neuroticism	0.43	0.06	0.937	7.58	<.001

There was a strong correlation between the two variables (β=.937): for each point in Neuroticism, Phobic Anxiety increased by 0.43.

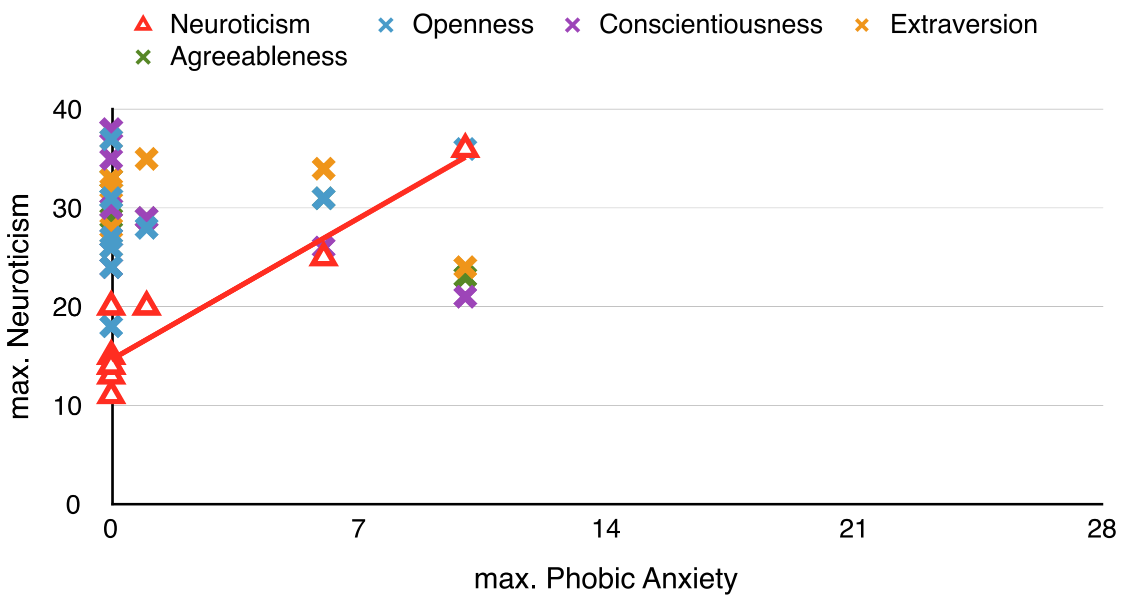

Figure 6.7: Explorers Who Were Higher in Neuroticism Felt More Phobic in Winter.

As we can see in Figure 6.7 above, most Explorers experienced zero Phobic Anxiety in winter: most of the red triangles are clustered on the x-axis' zero point.

All in all, Neuroticism explained 87.8% of variation in Phobic Anxiety, this result only had a chance smaller than 0.01% of occurring if there were no effect. On the other hand, this result was 590 times more likely under the best possible alternative. According to the BFHT, Neuroticism was the best alternative to the null hypothesis by a factor of 238. When Albert's data were removed, this model held (P(M)=0.031, P(incl|data)=0.127, BF_M=4.52, BF_{01}=1.00) but the factor was reduced to five (P(M)=0.026, P(incl|data)=0.127, BF_M=0.82, BF_{01}=4.97, error%=9.301E-04). This suggests that Explorers who were high in neuroticism felt more Phobic Anxiety over the winter.

Paranoid Ideation

There were seven models which performed similarly when predicting Paranoid Ideation based on personality traits (Table 6.26).

Table 6.26

The Best Models Predicting Paranoid Ideation in Winter.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Neuroticism + Openness	0.031	0.133	4.77	1.00	0.002
Neuroticism	0.031	0.111	3.86	1.21	0.002
Neuroticism + Openness + Extraversion	0.031	0.067	2.23	1.99	0.002
Neuroticism + Openness + Conscientiousness	0.031	0.067	2.22	2.00	0.002
Neuroticism + Openness + Agreeableness	0.031	0.062	2.05	2.16	0.002
Neuroticisim + Conscientiousness	0.031	0.048	1.56	2.78	0.002
Neuroticism + Extraversion	0.031	0.047	1.52	2.86	0.002
Null model	0.031	0.015	0.47	8.85	0.002

The best model was Neuroticism + Openness, it was moderately supported (BF_M=4.77) and outperformed the null model moderately (BF_{01}=8.85). The analysis of effects however, suggested that only Neuroticism should be included (P(incl)=0.500, P(inclIdata)=0.787, $BF_{inclusion}$=3.70) but this support was just over the threshold for moderate evidence (BF_{incl}>3).

The classical model included Neuroticism and Openness, based on the results of Table 4.27. The overall model significantly predicted Paranoid Ideation in winter ($F_{(2,9)}$=11.42, R^2=.765, p=.006, VS-MPR=11.59).

Table 6.27

The Coefficients of Neuroticism and Openness Predicting Paranoid Ideation.

Source	B	SE (B)	β	t	p	Tolerance	VIF	Eigenvalue
(intercept)	-10.05	3.34		-3.01	.020			2.00
Neuroticism	0.31	0.09	.686	3.59	.009	0.92	1.09	0.09
Openness	0.23	0.12	.383	2.01	.085	0.92	1.09	0.02

The coefficients in Table 6.27 suggest that only Neuroticism was a significant predictor of Paranoid Ideation, it correlated moderately (β=.686): for each point in Neuroticism, Paranoid Ideation increased by 0.31 points. The correlation between Openness and Paranoid Ideation (β=.383) was moderate in strength but not significant (p>.005).

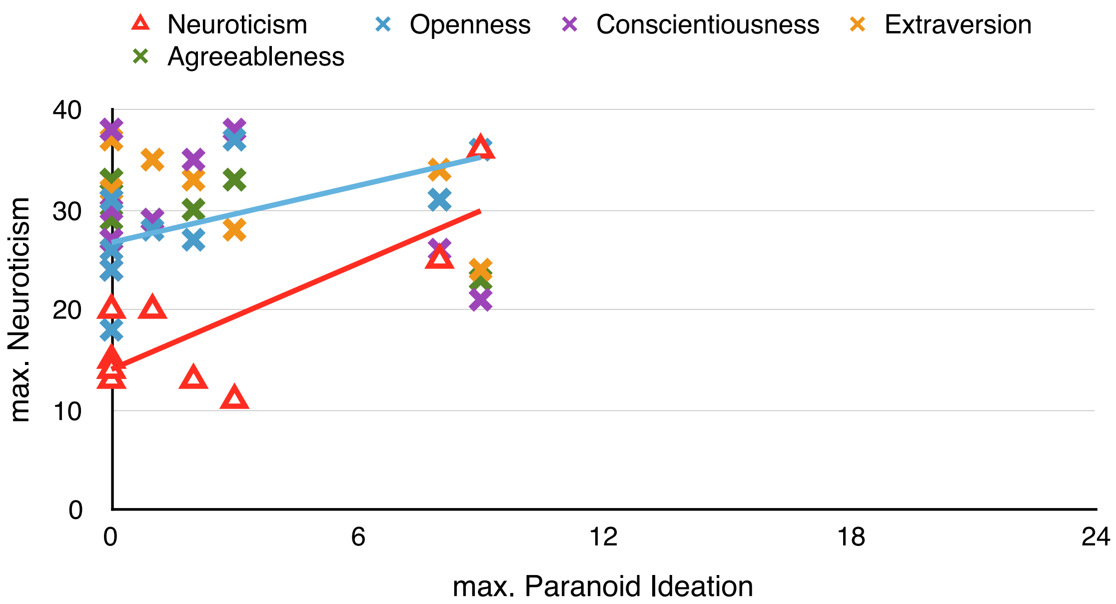

Figure 6.8: Neuroticism Predicts Paranoid Ideation in Winter.

Altogether, Neuroticism and Openness explained 76.5% of the variance in Paranoid Ideation in the winter. This finding only had a 0.06% chance of occurring if there were no such effect and was 12 times more likely under the best possible alternative hypothesis. BHFT suggested that the best possible alternative was Neuroticism + Openness, which outperformed the null model by a factor of approximately nine. When Albert's data were removed, the best possible model was Neuroticism on its own (P(M)=0.031, P(M|data)=0.127, BF_M=4.52, BF_{01}=1.00). This suggests that Explorers who were higher in neuroticism developed more paranoid ideations over the course of the polar night.

Altogether, these findings show that Explorers with higher self-reported Neuroticism were likely to experience more emotional complications during the polar night. They were likely to feel more sad, be more sensitive, angry, and hostile; and they worried more about things outside of their own control. Vigor, the one positive aspect of well-being that was measured, was influenced by Neuroticism and Agreeableness: more agreeable and less neurotic Explorers felt more vigorous in winter. This implies that Explorers with a more innate tendency to worry about things were more likely to experience unpleasant emotional states and less likely to experience positive states. These analyses, however, only tell us about the collective emotional state of the Explorers. They do not tell us anything about their suitability for the mission because their personality traits and emotional states were not analysed in conjunction with mission suitability. Suitability for the mission was inferred from the peer-nominations for being chosen for another winter

("Winter Again"), based on the assumption that the more often his/her peers chose a given Explorer, the more suitable he/she must be.

5.3: Which Traits and Behaviours Make a Successful Wintering Candidate?

These analyses aim to predict Winter Again from personality traits and the peer-nominated qualities. For these analyses, the peer-nominated qualities were split into two groups: the Professional qualities (Job Knowledge, Hardest Job, Hardest Working) and the Personal qualities (Calm, Friendliest, Closest Friend, Leadership). Three steps were undertaken to determine the most important aspects of being chosen for another winter: first, a model on the personality traits was run. Then, a Professional model was run, followed by a Personal model. The goal was to combine the most influential effects of each model into a final model so that a candidate's ideal personality traits, professional behaviours and interpersonal behaviours would be known.

However, none of the personality traits were influential on whether or not someone was chosen for another winter, the best possible model was the null model ($P(M)=0.031$, $P(M|data)=0.083$, $BF_M=2.79$, $BF_{01}=1.00$). None of the personality traits were recommended to be included.

The Professional model of being chosen for another winter showed that the best model was Job Knowledge, but Job Knowledge + Hardest Job and Job Knowledge + Hardest Working were similarly good predictors (Table 6.28).

Table 6.28

The Influence of the Professional Traits on Winter Again.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Job Knowledge	0.125	0.401	4.69	1.00	
Job Knowledge + Hardest Job	0.125	0.195	1.70	2.06	0.002
Job Knowledge + Hardest Working	0.125	0.167	1.40	2.40	0.003
Null model	0.125	0.029	0.21	13.81	0.001

There was moderate support for Job Knowledge (BF_M=4.69) but only anecdotal evidence for Job Knowledge + Hardest Job and Job Knowledge + Hardest Working (BF_M<3). The only effect whose inclusion was supported was Job Knowledge (P(incl)=0.500, P(incl|data)=0.853, BF_{incl}=5.82). The classical linear regression confirmed this relationship ($F_{(1,9)}$=18.77, R^2=.701, p=.003, 95%CI[0.37|1.22], VS-MPR=24.54): there was a strong correlation (β=.837) between Job Knowledge and Winter Again with each point in Job Knowledge resulting in a 0.77 increase in Winter Again (B=0.769).

The best Personal model was Calm + Friendliest.

Table 6.29

The Influence of the Personal Traits on Winter Again.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Calm + Friendliest	0.063	0.253	5.09	1.00	
Calm + Friendliest + Leadership	0.063	0.239	4.70	1.06	0.002
Friendliest	0.063	0.140	2.45	1.80	8.564E-04
Null model	0.063	0.004	0.05	58.37	8.519E-04

Calm + Friendliest barely outperformed Calm + Friendliest + Leadership:

both models received moderate support (BF_M>3) and Calm + Friendliest was only better by a factor of 1.06. Compared to the null model, however, Calm + Friendliest explained this data 58 times better. The analysis of effects suggested that only Friendliest should be included (BF_{incl}=7.87). The linear regression confirmed that Calm and Friendliest were significant predictors of Winter Again ($F_{(2,9)}$=27.00, R^2=.885, p<.001, VS-MPR=94.84). The individual coefficients revealed a moderate correlation between Calm and Winter Again whereby for each point in Calm, Winter Again increased by 0.34 points (B=0.34, β=.411, p=.035, 95%CI[0.03|0.65], VS-MPR=3.16); and a moderate correlation between Friendliest and Winter Again (B=0.52, β=.641, p=.005, 95%CI[0.22|0.83], VS-MPR=14.54). For each point in Friendliest, Winter Again increased by 0.52 points. For the final model, Friendliest, Calm and and Job Knowledge were selected as predictors.

Friendliest + Job Knowledge was the single best predictor of Winter Again, it moderately outperformed even the next-best model which was Calm + Friendliest + Job Knowledge.

Table 6.30

Friendliest + Job Knowledge Was the Best Model for Winter Again.

Model	P(M)	P(M|data)	BF_M	BF_{01}	error%
Friendliest + Job Knowledge	0.125	0.710	17.11	1.00	
Calm + Friendliest + Job Knowledge	0.125	0.129	1.035	5.51	1.688E-04
Null model	0.125	0.001	0.01	516.06	1.593E-04

The analysis of effects suggested only the inclusion of Friendliest (BF_{incl}=26.24), and of Job Knowledge (BF_{incl}=6.41). The ensuing classical linear regression yielded a significant main effect of Friendliest and of Job Knowledge on Winter Again ($F_{(2,9)}$=62.60, R^2=.947, p<.001, VS-MPR=1047).

Table 6.31

The Multiple Regression of Friendliest and Job Knowledge on Winter Again.

Source	B	SE (B)	β	t	p	Tolerance	VIF	Eigenvalue
(intercept)	-0.05	0.14		-0.38	0.715			2.47
Friendliest	0.49	0.09	0.598	5.70	<.001	0.687	1.46	0.33
Job Knowledge	0.48	0.10	0.503	4.80	.002	0.687	1.46	0.20

Table 5.32 shows a moderate correlation (β=0.598) between Friendliest and Winter Again: for each point in Friendliest, Winter Again increased by 0.49 points (p<.001, 95%CI [0.29l0.69], VS-MPR=69.42). Similarly, for each point in Job Knowledge, Winter Again increased by 0.48 points (p=.002, 95%CI[0.24l0.74], VS-MPR=29.87).

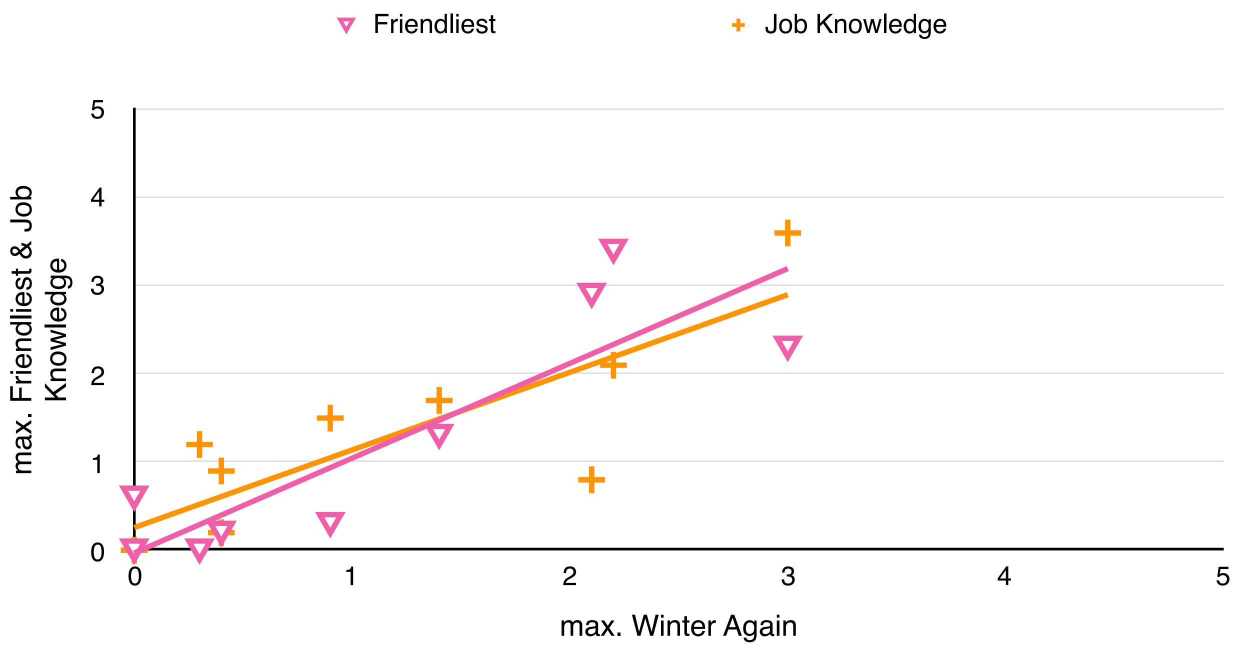

Figure 6.9: Friendlier and More Knowledgeable Explorers Were Considered More Suitable.

Figure 6.9 above visualises that the friendlier and the more knowledgeable about their work any given Explorer was perceived, the more likely they were chosen to be for another winter by their peers. This model held, when Albert's data were excluded (P(M)=0.125, P(M|data)=0.606, BF_M=10.76, BF_{01}=1.00) and explained my data approximately 155 times better than the null model (P(M)=0.125, P(M|data)=0.004, BF_M=0.028, BF_{01}=154.53).

6.4 Conclusions About the Ideal Winter Candidate

This chapter provides an original contribution to science in that it did not attempt to predict a person's adaptation or station commander ratings from personality as other papers have done unsuccessfully (see Palinkas, 1992, 2003 for reviews). Instead it attempted to predict the Explorers' self-reported winter moods and mental health from their self-described personality traits. This gives a very different insight because it is a more direct measure of the individual's personal experiences and does not involve ratings of adaptation by other people. It also does not use the abstract concept of adaptation but focuses on possible emotional outcomes of certain personality types. It also made the first attempt to predict a peer-nomination system with personality-based traits. As such, this chapter provides valuable new insights into future selection techniques for ICE crews.

Explorers are more prone to suffering from emotional complications if they are more neurotic. When Albert's data were included, almost all mood and mental health variables except for fatigue were affected by neuroticism: the higher in neuroticism the Explorers described themselves, the higher their emotional disturbances were. There was no personality-based prediction of POMS-Fatigue when Albert's data were included, and no predictions of Psychoticism, Sensitivity, OCD, Anxiety and Hostility when his data were excluded. This, however, does not allow any conclusions about their ability to fit in with the team or their ability to do their duties. It merely shows that Explorers with higher neuroticism were more depressed, confused, anxious and hostile over the polar night and that they needed more time alone. These models were re-run without Albert's data; his choice to leave the station early implies that he was unusually affected by the mission. Without his data, neuroticism lost some of its influence: there was moderate (BF_M<10) instead of strong evidence in relation to tension, depression, phobic anxiety, and anger-hostility; while psychoticism, sensitivity, OCD, anxiety, hostility, and paranoid ideation were no longer predicted by it at all.

The Explorers who were most likely to be chosen for another winter did not exhibit any particular personality traits. Instead, they were perceived as friendly to everyone else on the team, and knowledgeable on their job. These two aspects predicted being chosen for another winter successfully, with and without Albert's data. This provides an answer to the research question of the ideal winter candidate insofar that a successful candidate must not only feel happy in the hardships but also be experienced positively by their co-workers.

Altogether, statistical prediction of winter adaptation has been difficult in polar settings (Grant et al., 2007). Gunderson (1973) discovered very similar results with regard to the peer nominations so it may be worthwhile to consider station members' opinions of one another rather than the abstract concept of "adaptation". It is likely that a person who handled one wintering well, and who was well-liked by one expedition, will continue in this manner in the future.

While extraversion has been linked to being less likeable in polar settings (Rosnet et al., 2000), this was most apparent in the qualitative analysis where more talkative Explorers were resented by their colleagues. Given the importance of team cohesion in winter, this is a vital parameter to keep in mind.

7. Discussion

Ten Explorers at the isolated Polish Polar Station were investigated over the course of a year-long expedition to Svalbard. Their mood and mental health were assessed just after they arrived, at equinox, during their winter isolation, in spring and in the summer before their departure. At these time points, they were also interviewed. Their quantitative contributions were compared to that of a control group who did not go on a polar mission and was matched for age, sex, and education.

7.1 Statement of Originality

This mixed-methods approach is my study's key strength, and one of its original contributions to polar psychology. The quantitative measures provided insight into fluctuations over time in a fashion that is comparable to Antarctic literature (see Section 7.3 onwards). This eases the comparison between the effects of ICE at both poles and furthers the knowledge into Arctic ICE. Such thorough observations of mood and mental health in an Arctic team are a new contribution. The predictions of winter affect based on personality traits are a new approach to selecting Arctic winter candidates (Section 6.2). While the peer nominations were based on Gunderson's (1973) work, applying them to a Polish Arctic team instead of an Anglo-Saxon or Australasian team in Antarctica is also original to this study.

Phenomenological interviews have not been conducted in ICE research altogether and they provide original and new insights into life in Hornsund. They integrated well with the quantitative measures: while the questionnaires of cognitive tests provide a standardised insight into how the Explorers felt, their lived experiences helped illuminate not only how they felt but also why they felt that way. In these interviews, the Explorers related what mattered to them at the station, what did not matter, what brought them joy or distress. This helped understand the quantitative findings better: many outside researchers assume that the standardised and quantified measures show emotional or cognitive problems over the polar night because of the darkness, the isolation or the confinement. The qualitative analyses bring to light that for each individual Explorer, the single greatest stress-inducing factor was different: for example, Maria felt lonely in her team, Elwira did not like being unable to relax outside by herself, Jakub found the lack of sunlight and privacy difficult while Karol worried mostly about his team's emotional state and cohesion. However, the qualitative work in this project was by no means only a supplement to the quantitative work. It also provided new insights on its own which will be outlined in the following alongside the quantitative findings.

The last of the original methodology aspects is the use of the SART and the TEA. Previously, the ANAM-ICE was used most frequently with varying results (see Section 1.5.2). The use of the SART and TEA which are well-documented in the areas of traumatic brain injury and neurodegenerative diseases yielded very different results (see Section 7.4), but had never been carried out before in ICE settings.

Statistically speaking, this study provides a new approach, too. The approach is outlined in Section 2.8 and in Temp et al. (2017). The application of BFHT reveals the presence and magnitude of effects which allowed the distinction between practice effects, mission time passing, seasons and group membership in this thesis. This is more informative than the previously published literature using NHST.

Another original aspect of this study is the case of Albert. As noted before, such a detailed psycho-cognitive assessment alongside phenomenological exploration of the lifeworld has not been produced in polar psychology case studies in the last six decades. In fact, no polar case studies have been published at all. However, much can be learnt from this approach: which personality type may be most vulnerable in polar night, what they may be vulnerable to, why they may be vulnerable and how to handle this vulnerability. It also shows that a person's subjective experience of herself or himself may differ greatly from objectively measured performance. For example, Albert felt that his cognitive skills had worsened when to an extent, they had actually improved.

7.2 Answering the Research Questions

This study provides new answers to several open questions about a Polish team of eleven people who wintered at an isolated research station in the Norwegian High Arctic. These answers will be outlined here before they will be discussed in the light of the previous literature in Sections 7.2 to 7.4.

7.2.1 Did the Explorers' Mood and Mental Health Change over Time?

Based on previous studies outlined in Section 1.4, I expected that negative moods and mental health issues would appear most frequently and present most intensely during the polar night. This, however, was not the case. There were changes over mission time – vigor and confusion continuously declined – but the most intense psychological distress was reported after the winter isolation, in spring. Depression and hostility increased throughout the mission but were highest in spring. The changes in confusion were strongly influenced by mission time, while there was a moderate influence on depression and hostility. None of the Explorers exhibited strong enough symptoms to warrant a diagnosis with any mental health disorder. Rather, these results are symptomatic of a heightened need to be alone before and after the isolation period but not during the isolation period. In their interviews, the Explorers reported that the time at the station brought them closer to their co-workers: from co-workers to an unchosen family to genuine friends. The physical and emotional proximity among the team was what they found most stressful at all times because they had to control their own behaviour continuously. Rather than personal emotional suffering due to the darkness or isolation, they found the confinement most difficult because they could not be hostile or impolite to their peers when tensions arose. The team were well-aware of their cohesion's fragility.

7.2.2 Are Any Fluctuations to be Expected Even Under Normal Circumstances?

The Explorers' confusion and vigor differed from the Time Controls. Explorers were much more confused during the first summer measurement and fluctuated more altogether. This high confusion is likely explained by the fact that the Explorers' mission began during their first summer. During their entire mission, new and confusing situations would have arisen more frequently than for the Time Controls in their home environment. In the case of vigor, the null hypothesis could be rejected by NHST but neither the type nor the strength of the effect could be determined using BFHT. Explorers reported higher levels of vigor during the first summer and autumn measurements while in winter, both groups felt equally vigorous. After winter, the controls' vigor increased. Altogether, the Explorers reported greater variation in vigor levels which is consistent with several Antarctic isolation studies (for example Peri et al. (2000), Palinkas, Johnson, Boster et al. (2004) and Reed et al. (2001), see Section 1.4, *The WOS Across Cultures*).

7.2.3 Did the Explorers' Cognitive Functions Change over Time?

I expected changes across all investigated domains: sustained and selective auditory and visual attention, cognitive flexibility, reasoning speed and accuracy, visual learning and recognition. I did not specify at what time in the mission these changes would occur, or in which direction they would go. The domains which were the most prone to change was visual learning and retention: the Explorers learnt and retained more items during the polar night than at equinox. Overall, no group differences emerged between seasons and testing time was more influential than season. This suggests that in winter, the Explorers exhibited practice effects rather than effects of the polar night or mission time passing.

There were no changes at all over time in logical reasoning skills. There was a practice effect in visual attention: Explorers became faster over time while maintaining similar accuracy levels. This effect was not present when the controls were included. However, the Explorers demonstrated a lower visual accuracy at equinox, and at the third testing time. Omissions were at a very low rate, indicating that the low accuracy performance of my Explorers was not due to lack of motivation.

For auditory attention, there was moderate support for the null hypothesis that neither cognitive flexibility nor selective attention were affected by mission time.

7.2.4 How Did the Team Experience Their Lives at the Polish Polar Station?

The Explorers took great pride and joy from acquiring new knowledge and master challenging skills in the first summer phase. Their workload was very high but the overall experience was pleasant. They considered the station's isolation from amenities difficult because this meant that the personnel there had to be completely self-reliant. They had to manage supplies for a whole calendar year which took practice and effort. The social culture at the station was thriving with an exchange of knowledge and skills from international visiting scientists who enjoyed meeting each other. Nevertheless, the most stressful aspect of the mission were the people. Living together meant that privacy was greatly reduced and finding time to rest and adjust was difficult for my participants. Because of their isolation from additional supplies or equipment, team members who were negligent with those were also perceived as problematic. This was particularly the case in relation to food supplies. The Explorers wondered how the overall expedition and particularly the polar night would affect themselves; some people anticipated that the darkness would be difficult for them and thought of coping strategies.

In January, the differences between Hornsund and their home lives were more of a concern. The Explorers found it difficult to be confined indoors by the weather because contact with their colleagues was inevitable. Simultaneously, their environment mesmerised them with its glaciers, the moon light and the northern lights. At this point, everyone had become aware of their colleagues' character flaws as well as their own personal character flaws. They saw each other as a family rather than friends because friends are selected from a variety of people in normal life. Family, on the other hand, is not chosen. The Explorers concluded that in order to survive at the station they would need to showcase the best aspects of their personalities while overlooking each others' flaws. This was exhausting and required a lot of emotional self-monitoring. The Explorers spent their emotional resources on loosening their connections with their home lives and connecting with their Hornsund lives. This pre-occupation with their selves led them to reflect on their past behaviours at Hornsund or prior to arriving there, their present behaviours and experiences and how they wanted their future to be. Everyone was sure that polar night was the hardest part of their expedition and that the coming months with more opportunities for field work would be more enjoyable. The two people who struggled to connect with the team at Hornsund tried to compensate by maintaining connections with their friends and family at home.

At hindsight, in June 2016 the Explorers found the quiet of winter easier and less tense than either the preceding or the following summer. They noticed that they themselves had become less concerned about their own safety as time passed because their lives at the station had settled into a routine. Leaving the station and its isolated confinement behind was something they looked forward to, the possibilities of going to the cinema or to a pub, to meet friends and spend time with their biological families. The station family was now seen as friends as the group neared its departure and subsequent disbanding. The Explorers were melancholic to leave Hornsund's beauty and adventures behind; but they were looking forward to being able to use normal coping strategies for social stressors again. The confinement with their colleagues who became their family and then their friends resulted in everyone constantly prioritising the team over themselves which led to an emotional exhaustion. While they thought it would be strange to no longer see everyone everyday in Poland, they also looked forward to re-connecting with their previous lives. See Figure 4.2 in Section 4.5 for this model of experiences.

7.2.5 What Made a Good Winter Candidate?

This research question was addressed in three ways: personality traits were used to predict emotional complications during the winter isolation, and peer nominations were used to understand which behavioural traits were most valued. Qualitatively, the Explorers described desirable and undesirable behaviours. Altogether, a more neurotic personality predicted greater emotional complications over the winter phase. These complications related to internal suffering and a struggle to cope, they did not affect how the participants who were higher in neuroticism were seen.

This suggests that people with high levels of neuroticism are more prone to their own emotional struggles which in turn may lead to their evacuation because they can no longer cope, as happened with Albert. Albert was a well-liked team member who performed his duties but he needed to leave for his own mental health's sake. The potential to be happy at the station is an essential quality for a winter candidate.

The Explorers sourced their happiness in their sense of wonder at their environment's natural beauty, and in their feelings of accomplishment and pride of withstanding any adversity such as the confinement with their colleagues and the absence of light. Albert, however, struggled to find such happiness at the station. He was interpersonally well-liked and professionally appreciated by his colleagues; there were no complaints about his performance or behaviour. However, he was very unhappy and struggled to get the inspirational input that would have let him thrive. Albert's problems were rooted in the station's innate routines that were set and rarely deviated from, but they also related to his own innate tendency to worry over issues that were beyond his control.

In the eyes of their co-workers, a good winter candidate is someone who brings professional competency, a will to work hard and interpersonal friendliness to the team. Such a person will be not just accepted but also well-liked by his or her peers. This was not related to any self-reported personality traits which implies that personality has little applicability for selecting expedition members that will be valued by their team.

Behaviours that the Explorers described as inherently unpleasant and unwelcome amongst themselves were talkativeness and an over-interest in other people's lives; frequent, well-meaning but ill-informed or incompetent advice, and an overconfidence of personal competency in the field. These behaviours were perceived as intrusive in personal manners and professional boundaries. Excessive field confidence was also physically dangerous to the other members of any potential field team because they would have to look out for this particular person.

7.3 An Integrative Model of Wintering at the Polish Polar Station

Based on my psychological, cognitive and phenomenological findings, I developed the following model. In Figure 7.1 below, the cognitive aspects are denoted by triangles and the emotional aspects are denoted by circles.

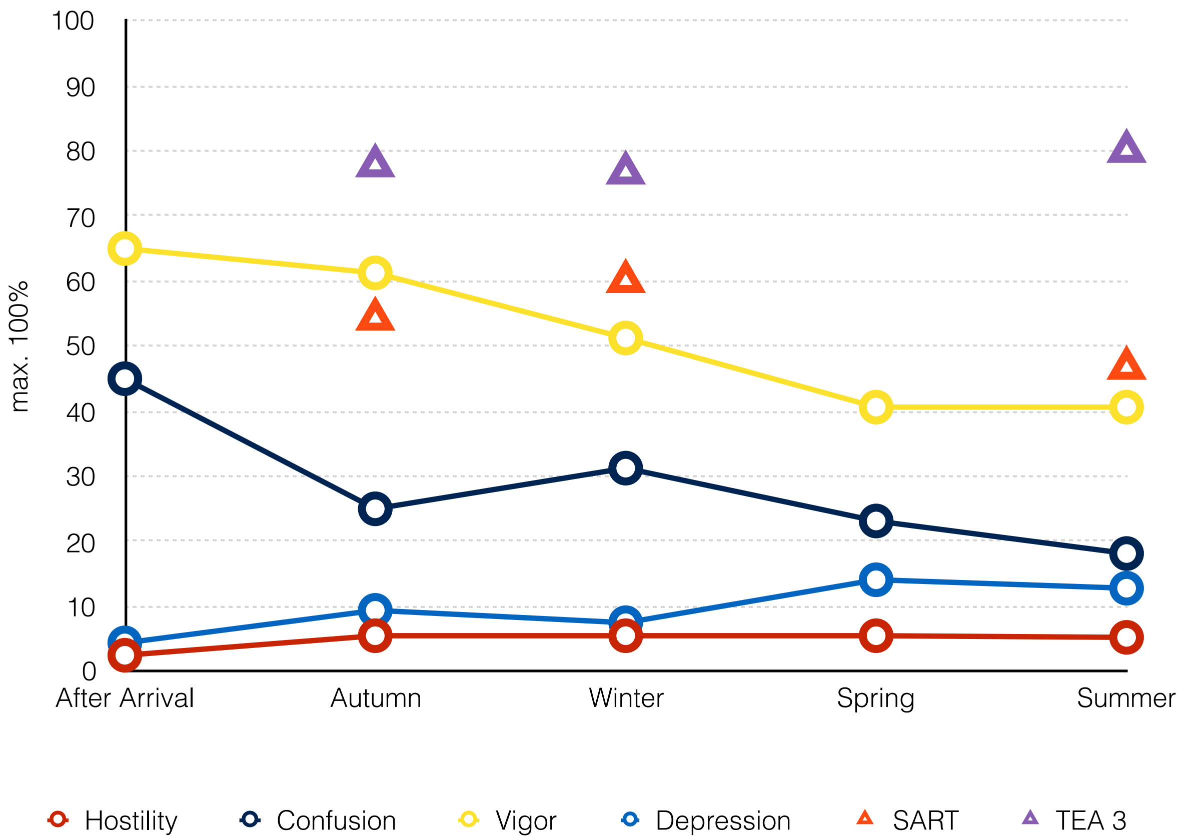

Figure 7.1 The Integrative Model of the Explorers' Experiences.

Because the different questionnaires used different maxima for the raw scores, the y-axis in Figure 7.1 shows the intensity of each feeling as a percentage of their individual maxima. For example, hostility never reached intensity levels beyond 5% of what could have been reported on the SCL-90-R while vigor reached up to 65% of the possible maximum on the POMS. This allows us to see that vigor was felt more intensely than hostility.

Figure 7.1 shows how as the mission progresses, vigor and confusion decline in intensity. This fits in with the Explorers' personal narrative of settling into the station in July after their arrival and building a routine for themselves as time passed through to September. These two points show a lot of excitement about the station's environment as well as the confusion that comes with the novelty of this environment and the thrill of learning new skills from new people (refer back to Section 4.4.1, *Thriving by Learning*). This excitement lessens over time and the confusion does, too, as the Explorers build an everyday life for themselves. Polar night shows a small increase in confusion as they get used to the prolonged darkness, confinement, and isolation. Instead of focusing on their duties, the reduced workload of this phase meant that they could focus on their interpersonal interactions. They continuously monitored their own feelings towards the other team members and controlled their behaviours in order to be accepted by the group. The Explorers had previously assumed polar night to be the hardest aspect of their mission because of the environmental duress. But after the isolation ended in the spring, negative feelings increased while vigor continued to decrease. It is possible that the Explorers monitored their own feelings and behaviours less closely in spring because they assumed that the hardest part was behind them so they could relax, leading to increased negative feelings in April. The decrease in vigor along with the increase of depression and hostility indicate that the Explorers were becoming more tired of their mission, and of their co-workers. By answering these research questions in this study's Explorers, some insight into more general polar winter experiences can be gained. This will now be discussed in combination with the previous literature.

7.4 Fluctuations in Polar Well-Being

My findings suggest that the most emotionally difficult part of the mission was in spring, after the winter isolation ended. This is consistent with findings from Japanese and French Antarctic personnel (Décamps & Rosnet, 2005; Otani et al., 2004) but contrary to large parts of the existing literature which suggest that winter is the most difficult phase; especially depression has been found to peak then (Palinkas, Johnson, Boster, & Houseal, 1998; Premkumar et al., 2013; Reed et al., 2001; Strange & Klein, 1973; Xu et al., 2003). Similarly, previous literature has shown a linear tension increase over Antarctic missions (Wood et al., 2000), or a decrease (Palinkas & Houseal, 2000) but in my Explorers, no change in tension was reported.

A continuous decline in confusion and vigor, however, has been documented in American and Chinese Antarctic personnel (Palinkas & Houseal, 2000; Palinkas et al., 1998; Xu et al., 2003). According to Gunderson (1968), every station member became more irritable over the course of the polar night. While the quantitative measures of hostility or anger did not reflect this, the Explorers experienced an increased awareness of their social interactions during the winter. The weeks during which the weather confined them indoors at all times and/or the internet was not working were particularly stressful because even little everyday differences became disproportionately important and caused tensions. This is similar to Stuster's (1998) observation of trivial things becoming explosive in nature. The team was carefully aware of how fragile peace among them was and made their best efforts to conceal any hostilities in order to increase their chances of survival and success. They also presented the best side of their individual characters to everyone else in order to be liked and valued. This also fits in with Sandal's (2000) description of interpersonal interactions becoming increasingly stressful over the winter period. However, in the present sample there were no cases of active ostracisation of any team members. Like Sandal's (2000) participants, Maria reported feeling lonely but this was because she was lacking a close friend, not because the others behaved hurtfully towards her.

Palinkas, Johnson, Boster, et al. (2004) suggested that Polish Antarctic personnel sought advice less frequently over their mission; but the more they did, the more tense, angry, confused, fatigued and depressed they felt. This suggests that their participants were aware of their emotional struggles and sought help but Palinkas, Johnson, Boster, et al. (2004) showed that fellow crew members were poor sources of support because they underwent the same stressors. In my Explorers, advice-seeking and general interactions were not quantified but as Jakub pointed out in January: they chose to hold fewer social gatherings in winter, each individual sought out privacy (see Section 4.4.2, *Privacy is Paramount*). Palinkas, Johnson, Boster, et al. (2004) suggested that more frequent interactions were associated with higher levels of vigor, so it is possible that my Explorers felt less lively in winter because they spent less time together. Or they might have chosen to spend less time together because they felt less lively.

While quantitative changes in mood and mental health have often been attributed to the lack of light (Ikegawa et al., 1998), the overall isolation (Blackburn, Shurley, & Natani, 1973) or hormonal fluctuations (Reed et al., 2001), such causal attributions are not easy with the present data. Establishing correlations between hours of daylight and well-being is not possible because the hours of light are always zero in the winter and always 24 in the summer. Jakub (see Section 4.4.2) attributed his personal struggles to the lack of daylight which he countered by spending as much time outside as possible, but he also pointed out that it was impossible to distinguish which of the missions's aspects – isolation, confinement, darkness – was the most influential one. He saw them as interconnected. Altogether, the single most intense stressor on the team was the confinement: everyone described living together as very difficult. This was not due to disagreements among the team but due to the immense effort each individual made not to cause any disagreements. These efforts included showing only one's best traits, overlooking traits one did not like in the other people, and continuously monitoring one's own feelings towards others. There was a communal effort not to hurt any team member's feelings and not to intrude upon anyone's privacy. This finding fits in with Gunderson's (1968) observation of irritability among the whole team and also with Stuster's (1998) observation of trivial things becoming potential points of conflict. However, the present study illuminates these findings in richer details to the point where even one person's manner of holding a spoon irritated Jakub (see *People Annoy Me,* Section 4.4.2). This indicates an increased amount of tension in the team mid-winter despite the quantitative data not matching the subjective experiences of the team. On the other hand, the team became more comfortable and relaxed around each other. This was reflected in their clothing which was increasingly less formal as the mission continued. During the final summer measuring point, the station was to host a landing party from a ship and Julia remarked to me that this was a special occasion because she was not wearing leggings but jeans. This highlights the distinction between being comfortable in the team and less comfortable around newly arrived strangers. Ikegawa et al. took regular photos of their participants and observed that they, too, dressed less formally as the mission progressed.

These observations did not fulfil the criteria for the winter-over syndrome (WOS) as the WOS presents with peaks of negative moods in mid-winter (Palinkas, Cravalho, & Browner, 1995; Palinkas, Johnson, & Boster, 2004; Palinkas & Suedfeld, 2008) and the Explorers felt worst in spring, according to the questionnaires. According to the interviews, the Explorers found the confinement most difficult of all aspects of their winter, but the winter itself was their favourite phase. They enjoyed the decreased workload, set routines and quiet resting time that followed the very busy summer of their arrival. For them, this was when they settled into their home and into their new family at the station. This produced a feeling of comfort among them but also a sense of achievement in the face of the adversity of the weather conditions. This is highly inconsistent with the winter-over syndrome and suggests a salutogenic effect of polar night on my Explorers.

Their emotional struggles after the isolation ended partially support the third quarter phenomenon (TQP) whereby participants struggle to cope with having another half of the mission left (Bechtel & Berning). It has been shown among American, mixed Scandinavian and French Antarctic personnel (Bechtel & Berning, 1991; Décamps & Rosnet, 2005; Palinkas & Houseal, 2000; Sandal, 2000). However, the Explorers of the present study reported the most negative feelings in April when the mission had only got its last quarter left. This suggests that the most emotionally difficult phase was the end of the third quarter (April), not its beginning which marked mid-winter (January).

7.5 Fluctuations in Polar Cognition

The Explorers exhibited practice effects with regard to visual learning and retention, these were particularly pronounced in polar night but partially extended to the summer before their departure. This fits in with Mäkinen et al.'s (2006) finding that laboratory conditions of cold produce practice effects, and Palinkas et al.'s (2005) observation that learning improved over Arctic winter. Both these studies were conducted in circumpolar residents, not in Arctic station personnel. My observation of improved retention in winter and summer contrasts that of Reed et al. (2001) who found that their participants' performance on a matching-to-sample performance declined over Antarctic residence. The finding that the Explorers improved over polar night but not the summer is similar to that of Brennen (1991) whose circumpolar residents performed worse in the Arctic summer. A new aspect of the present study is a dissociation between short and long delayed recall: short delayed recall improved only in the summer before their departure while long delayed recall improved only in the winter. It is possible that this is part of a learning effect because the Explorers learnt how the FLMT is conducted: perhaps, they only remembered having to do the long delayed recall in the winter and thus performed better. In the summer, they also remembered the short delayed recall and performed better, but at the expense of their long delay performance. In winter, the Explorers described a great level of interpersonal stress that stemmed from their constant self-monitoring; in the summer, their stress was more intrapersonal at the thought of leaving the station and returning to civilisation. It is also possible that these different types of stress produced these different performances in differently delayed recalls.

Similarly, there was a practice effect in visual attention: Explorers became faster over time while maintaining similar accuracy levels. However, these accuracy levels were unusually low for a sample of cognitively healthy adults which means that they made a high number of commission errors: they pressed the button, when “3” was on the screen and they were meant to withhold their response. Mohlenberghs et al. (2009) showed that lesions of the right inferior frontal gyrus often present with an increased rate of commission errors in patients with traumatic brain injury (TBI). None of the Explorers acquired a TBI during their mission, and none reported any prior to the mission. One possible explanation of the Explorers’ astoundingly high commission errors is that their right inferior frontal cortex (rIFC) was engaged in another activity which detracted from the resources they could divert towards the SART. Aron, Robbins and Poldrack (2014) point out that the rIFC inhibits responses, controls impulsive behaviours, and engages in intentional goal direction. It is therefore likely that my Explorers' high levels of discipline throughout the mission engaged their rIFC to such an extent that despite their SART performance was decreased in the form of numerous commission errors. The discipline they imposed on themselves related to dutiful task completion as well as social impulse control: everyone made a great effort not to cause any arguments. Personal thoughts and feelings were often withheld for the sake of the communal peace. These intentions and goals were necessary for survival and success and thus much more important than completing the SART as part of a research project. This is not to say that the Explorers were intentionally careless with their responses: in fact, they were highly motivated and frequently yelled at the computer in anger when they made a mistake in the SART. Altogether, this is a novel and highly interesting finding; particularly because the TEA elevator tasks were completed without any changes over time or group differences. The most complex of these tasks, the elevator with reversal, relates to attentional switching and working memory function (Robertson et al., 1996; Chan, 2000). The Explorers' accuracy was consistently between 75 to 80% while patients with brain damage perform around 40% (Chan, 2000). While Pääkkönen (2010) found an improved accuracy for complex cognitive tasks over Antarctic residence and Palinkas et al. (2005) noted a slower reaction time in the Arctic summer, the Explorers became faster and maintained a low accuracy for inhibition-related tasks simultaneously to high accuracy for attention-related tasks. Their performance is similar to the circumpolar residents of Mäkinen et al. (2006) who became faster at the expense of accuracy. This is a classical *speed-accuracy trade-off.* No such trade-off occurred in the present study's Arctic Explorers.

There were no changes at all over time in logical reasoning skills which is in contrast to Palinkas et al. (2005) who found an improved grammatical reasoning in their circumpolar residents. Pääkkönen (2010) also observed an improvement in complex cognitive tasks in Antarctic residents. The Explorers' reasoning accuracy was around 90% at all measuring points, this indicates a ceiling effect. The SPM may not have been sensitive enough to discover fluctuations in my highly educated sample.

These quantifications of the Explorers' inhibitory deficits and learning improvements fit with some of their personal experiences. Julia, for example, described that her concentration had worsened in January 2016 (see Section 4.4.2., *Forming New Bonds Now*) while her memory had improved (see Appendix C). Albert, on the other hand, felt that all his cognitive faculties were declining which was very painful for him. The quantitative measures did not support Albert's subjective perception of himself, his cognitive performance had not objectively worsened. Their personal experience and the objective measures of attention included in this study do not fit in with M. Barabasz's (1991) suggestion that her participants were more easily able to focus during polar night. If my participants had been able to focus better, there would have been an attentional performance improvement which there was not.

Palinkas et al. (2010) found that cognitive decline over polar residency can be countered with light therapy. My study did not apply light therapy and in the case of the visual memory task, the practice effects were stronger than the seasonal effects: under Arctic isolated conditions, light may not be a moderator of cognitive performance. Otherwise, my summer measurement would have differed from the winter measurement. Instead, the main moderator seems to be depleted inhibitory resources which affect my participants' performance in clinical tasks but not in their everyday lives.

Previous cognitive studies of Antarctic teams in isolation (Corbett, Middleton, & Arendt, 2012; Palinkas, 2010; Palinkas et al., 2001) have correlated cognitive performance with the hormonal fluctuations of the polar T3 syndrome (PT3) which has shown that participants who received T4 supplements outperformed those in a placebo group. The T4 group also performed better than at baseline (see Reed et al., 2001, p. 114, Figure 3). In the present study, no hormonal data could be collected so the role of T3 and T4 fluctuations in the Explorers' cognitive performance remains unknown.

While the WOS often features subjective claims of cognitive decline (Palinkas & Suedfeld, 2008), these claims are rarely verified objectively. The present findings do not support a cognitive aspect of the WOS because there was an improvement for visual learning and memory over the winter isolation. The Explorers' poor performance on the inhibition tasks was constant and not affected by seasonal changes. This does not fit in with either the WOS or the TQP.

In some cases, the NHST provided an indication of an effect in my data but the BFHT did not provide evidence in favour of mission time passing, seasons changing, or group differences. For example, among the Explorers there were unspecified NHST effects on how many items were recalled at the wrong time, and on items that were falsely recalled (confabulations). The BFHT, however, provided moderate support for the null hypotheses in these cases. Similarly, the NHST suggested that there were effects on how many distorted, rotated and persevered items occurred over time between the Explorers and controls. The BFHT supported the null hypothesis for distorted and rotated items but supported neither hypothesis for persevered items. This was also the case for omissions in the SART and the reasoning speed and accuracy of the SPM. The lack of support for the null hypothesis suggests that there is something going on that cannot be explained by mission time, season or group differences but that nevertheless requires an explanation. It has been suggested that unusual station life events or personal life events have a great impact on polar station personnel's well-being and cognitive functioning so perhaps these effects are due to personal circumstances of individual participants. In such a small sample even one distracted participant would greatly affect the group's mean. This could be the case for example with the SART omissions: Karol omitted an unusual number of stimuli. I suspect that this was not a lack of care or motivation but rather his immense preoccupation with Albert's emotional health and Elwira's physical health. While Karol took the test, Elwira was hospitalised in Longyearbyen for gastrointestinal issues. These close-knit interpersonal ties of the team lead to the final aspect of the findings that remains to be discussed.

7.6 The Ideal Winter Candidate

This study has shown that high friendliness and job competence will result in being chosen for another winter, while low neuroticism relates to fewer emotional complications over the winter. Additionally, the Explorers experienced bragging as unwelcome at the station; team members who were too talkative or too interested in other people's lives were perceived as uncomfortable to socialise with. Albert, the youngest team member, attributed some of his struggles to his age; Karol attributed some of Jerzy's cognitive inflexibility to his older age. These views suggest that a polar team should be of a coherent age range. Jakub emphasised that the most important thing for cohabiting over the winter was only showing the best possible side of one's character and always being what would in a normal society be considered exceptionally helpful.

Friendliness, competence and low neuroticism relate to the three Antarctic abilities necessary for a functioning team (Steel, 2015; Taylor, 1969): task ability, sociability, and emotional stability. The ability to complete one's tasks competently while getting along with others and remaining psychologically stable is key to Antarctic missions' success and survival (Steel, 2015, p. 364-366). The present study suggests that this is also the case for isolated Arctic crews.

However, personality traits in particular have rarely been related to psychological functioning in such a clear way as here: Steel et al. (1997) found that polar Explorers might be lower in neuroticism and higher in openness, conscientiousness and agreeableness than the norm; but Rosnet et al. (2000) have shown that personality was not performance-related. The Explorers' personality did not relate to being chosen for another winter in this study but there were no measures of performance collected to further strengthen this finding. Rather, Rosnet et al. (2000) suggest that highly extroverted team members are unpopular because they are perceived as intrusive to their colleagues' privacy. There were similar complaints among my team: two crew members – Maria and Jerzy – were considered too talkative and often asked questions when the others were tired, or talked at length about their personal experiences. Consequently, Maria herself experienced her winter as a lonely time; this is congruent with Schmidt et al. (2005) who have shown that female leaders become more stressed over polar missions because they perceive themselves to receive less social support from their fellow crew members than male leaders or generic team members. However, in Maria's case it was clear that she was respected and liked despite her out-going nature: she was considered a very hard-working and competent person which made her a valuable team member. Jerzy, however, was criticised as too self-involved and not flexible enough. Due to his age, he initially felt that it was his place to give well-meaning advice to the younger group members (everyone except Karol). This well-meant advice was, however, ill-received; the younger members found it intrusive and arrogant. Eventually, Jerzy was made aware of his unwelcome advice and he ceased to behave this way. This is in accordance with Law's (1960) description of Australian men at Mawson exhibiting *superiority complexes:* eventually, station life corrects the unwanted thoughts and behaviours of those who think themselves better than others, or better than they are.

Jerzy in particular brings another aspect of the ideal winter candidate to the table: it has been suggested that older men adjust better, and that married men are more likely to suffer from winter depression than unmarried ones (Palinkas et al., 1995). Jerzy did not have problems adjusting to the winter time, as far as his interviews suggested. But his marriage was greatly affected by his absence: his wife missed him more than he had anticipated and he divided his time between her, his work and his station life effortfully. This took his focus away from his duties and made life more complicated for him and the team. While Jerzy's self-reported well-being remained stable over the mission, his and the team's overall experiences were negatively affected by his personal attributes and problems.

Albert, as the youngest Explorer, attributed some of his problems to his own age, too. While this fits with the suggestion that older men may settle in better (Palinkas, Cravalho, et al., 1995), Albert attributed his problems to his confusion. He saw himself as younger and thus less sure of what aspects of his life mattered to him the most. While it is impossible to dispute Albert's experience of himself, the quantitative analyses suggested that neuroticism may have played a role in his emotional difficulties. Regardless of whether or not Albert's data were included in the analyses, more Explorers higher in neuroticism showed a tendency to be more depressed, anxious and sensitive in winter. While neuroticism did not predict being chosen for another winter, these results suggest that Explorers with an innate tendency to worry more report more emotional difficulties. While he was at the station, Albert was a popular team member: his co-workers were sad to see him leave and missed him when he was gone. This shows that while Albert found it difficult to be happy at the station, his contributions to the work and social lives of the team were valued.

Altogether, the conclusion is that the ideal winter candidate should be friendly, competent, willing to help, non-intrusive, not easily worried, with no marital ties outside the station, and happy to experience station life. In line with Crocq, Rivolier and Cazes (1973, p. 368), age did not appear as a relevant predictor of adaptation.

Combined, these results imply that while personality traits can be included in an initial assessment of applicants for polar service, they are not the most useful ones in determining who will be best liked or who will be friendliest. Personality psychometrics are valuable in distinguishing someone with unusually high neuroticism who may experience greater emotional distress over polar night. However, the most important traits for surviving successfully at the station were being competent at one's job and being friendly. These competencies are not easily measured by conventional psychometric assessments which may make it worthwhile to ask for references from any applicant's co-workers or line managers. However, Taylor (1973, p. 429) notes that positive references from previous employers have turned out to be wrong in New Zealand Antarctic personnel. Perhaps a selection questionnaire to be distributed among co-workers and friends of the applicants could be a good selection tool: station personnel will be working together and become friends over time, so such subjective evaluations might be helpful in advance. It is possible that peer-rated personality predicts winter suitability better than self-reported personality, but this remains for future researchers to determine.

7.7 Positive Experiences in Polar Environments

From the beginning of the Heroic Age of Antarctic Exploration, people have been drawn and drawn back to the continent. Frank Wild, for example took part in five Antarctic expeditions, more than Shackleton or Scott: Scott's *Discovery* expedition (1901-04); Shackleton's *Nimrod* (1908-09), *Imperial Trans-Antarctic* (1914-16), and *Quest* expeditions (1921-22); as well as Mawson's *Australasian Antarctic Expedition* (1911-14). This suggests that even in the early 20th century when modern day amenities were lacking, polar exploration must have held salient enjoyable qualities. This has been hinted at in empirical research over time: 12% of New Zealand personnel were interested in returning to Scott Base (Taylor, 1973, p. 227) and 25% of Australians volunteered for more than one mission (Wood et al., 2000). The observation of this study's Explorers supports this: Karol and Julia returned to the Arctic for different employment and Teo and his partner Lilia signed up for the next possible expedition to Hornsund. What, then, makes people go back to the Arctic?

The Explorers thrived on their unique sense of adventure. They derived this from their field work which placed them in a beautiful scenery featuring numerous unusual animals such as reindeers. The weather restrictions led to tension within the team when they were confined indoors but they also made the time spent outside much more precious to the Explorers. They experienced a sense of freedom which came from being in a place that few people had ever been to, doing things that were unusual and experiencing a natural beauty that was new to them. This fits in with Wood et al.'s (2000) findings, their participants also reported how enjoyable their field work was. This field work gave the Explorers a sense of wonder at the natural beauty but also a sense of accomplishment at overcoming challenging situations and reaching their professional and/or personal goals.

Additionally, lasting through the team tensions in winter when everyone was confined within the station gave the Explorers a sense of pride, too. They knew that ensuring team cohesion was necessary albeit difficult and worked hard to not express any hostilities towards anyone. They also made every attempt to maintain their personal mental health without relying on their colleagues too much. This gave them the experience of independence while caring for their team mates which they also enjoyed. Spending time outside in the beautiful nature of Hornsund was a coping strategy for some of the Explorers, at least during the non-winter months.

7.8 Limitations and Reflexivity

This section deals with the methodological shortcomings of the study, some of which were unforeseeable and others unavoidable. I will also outline certain aspects which I might have done differently.

7.8.1 Issues Relating to the Control Group

The first and foremost of the shortcomings is the collection of the controls (cf. Section 2.3.1). Ideally, the controls would have completed the study perfectly parallel to the Explorers: at the exact same months of the exact same years. This was not possible because my first journey to Svalbard – aboard the *Horyzont II* – saw me leaving Edinburgh on September 10 and returning on October 16. This was because the *Horyzont II* took approximately one week to reach Hornsund from Gdynia so we arrived on September 19, 2015. It took another 10 days to return to Gdynia because we were caught in a storm exceeding 13 on the Beaufort scale.

The images in Figure 7.2 below show a) the immensity of the waves and b)

Horyzont II's so-called *inclinometer.*

a) *Horyzont II* climbing a wave. b) *Horyzont II*'s inclinometer.[1]

Figure 7.2: The *Horyzont II* Caught in a Storm.

[1]Photograph of the inclinometer is courtesy of Jacek Lipkowski.

A ship's inclinometer indicates how much it tilts to either side, i.e. how close to capsizing it is (Chopra, 2011). This is sometimes referred to as the ship's *roll* or *rolling*. If all crew, passengers, and cargo weighed the ideal weight to keep the ship afloat and stayed located in the ideal place on board to keep the ship afloat, *Horyzont II's* absolute maximum roll would be 38° before she would be in danger of capsizing. As the inclinometer in image b) of Figure 7.2 indicates, its roll on our return journey far exceeded this. In light of the storm, the ship could only travel at three knots instead of eleven and we were delayed at port. Additionally, I suffered an injury and sought medical attention in Germany where my insurance covered it. These unforeseeable and unavoidable events led to me being away from Edinburgh for over a month and while I attempted to recruit controls, there was very little interest in participating in my study.

I had never before attempted to recruit a control group from the general population: my undergraduate research project was a within-subjects study of fencing referees and my postgraduate project recruited a clinical population including a control group from a German hospital. These recruitment difficulties could have been foreseen and avoided by me if I had had more experience in the matter. Among my Explorers, one was born in 1993 and one in 1990. For them, it was easy to recruit matching controls from Edinburgh's student population. Two more were born in 1959 and 1966, so the Healthy Older Adults Volunteer Panel facilitated recruitment of matching controls. However, this left six Explorers born in the 1980s for whom it was difficult to find matching volunteers. Attempts were made via student mailing lists, societies, social media groups, MyCareerHub recruitment, and the Polish community in Edinburgh.

Because of my prolonged absence from Edinburgh in autumn of 2015, it was too late to collect control data for the Equinox measurement; the slow success of the control recruitment led to the study effectively running until mid-2017 because a single healthy older adult only signed up in late 2016. This is far from ideal; the best possible outcome I could have hoped for would have been to test all participants of all groups at the same time. When this delayed protocol was launched in late 2015, there was no foreseeable reason why this would result in a confounding variable because the summer of 2015 should not differ much from the summer of 2016 or indeed, any other future summer. However, on February 22, 2016, the UK's then-Prime Minister David Cameron set the date for the UK's referendum to leave the EU ("Brexit") for June 24 of the same year. This date coincided with my final measuring point for the Explorers and the summer measurements of nine controls. Bar one exception none of my controls were British; many were EU nationals and some were from outside the EU. In a poll, Sime et al. (2017) have shown that young, non-British people mostly felt uncertain, worried, or scared about Brexit. It is possible that this led to an unexpected spike in symptom breadth and intensity in my controls for that particular summer measurement (see Figure 3.11, Section 3.2). Brexit anxiety would have affected the controls more than the Explorers because the Explorers were not British and not living in Britain; this was unforeseeable and at least on my part, unavoidable. While the combination of delayed onset, slow recruitment, and Brexit interference may have had a confounding effect on the controls' mood and mental health, this was a blessing in disguise for the cognitive data. The delayed, multiple starting points of cognitive testing meant that I could use my cognitive data in two ways: according to season and according to testing time, as outlined in Section 2.3.

7.8.2 Lack of Follow-Up

Secondly, a baseline point at home and a follow-up measuring point upon return would have been very useful. I met and recruited the Explorers during their Arctic preparation training in Gdynia in mid-May 2015. I spent some time with them in the evenings but subjecting them to cognitive or psychometric testing would likely have resulted in skewed results due to their unusual training load. I was not granted access to the team in Poland before or after that.

Similarly, I was cautioned not to test them upon their immediate return to Poland as they would be reuniting with their families after a long absence. Initially, a reunion of the Explorers was planned for late 2016 but it never took place. The Explorers departed Hornsund in July 2016 and went their separate ways: Karol and Julia returned to Svalbard’s capital, Longyearbyen, in August 2016 to undertake employment. Julia had found a new job and Karol settled back into his job of the previous 15 years. Elwira withdrew from contact for approximately a year, Henryk spent time planning a South America expedition, just to give a few examples. Long-term follow-up is very rare because of these logistic difficulties; even in the extended Antarctic literature only Palinkas (1987) followed up on his participants who were enlisted Navymen and thus, easier to track. In the Arctic literature, only Leon and Scheib (2007) followed up on their two participants who returned to their wives after their expedition. This leaves the question of how a Polish Arctic expedition affects its members in the long term open but the Explorers’ behaviour suggests that they enjoyed themselves: Karol and Julia returned to the Arctic straightaway, Jakub entered negotiations with the Institute of Geophysics for more work with them, Teo and his girlfriend Lilia who was on the 37th Polish Polar Expedition to Hornsund volunteered for the 40th expedition in 2017/18.

7.8.3 Unsatisfactory Interview Question Choices

Something that I could have done differently altogether is the choice of interview questions. This is not, strictly speaking, a limitation of my study as the interviews took place as planned. However, as I analysed my interview material with the questions “What is extreme?”, “What has changed?” And “How have you changed?”, I wished I had chosen even more open questions with fewer assumptions of extremity and change from my side. A better request would perhaps have been “Tell me about your life at the Polish Polar Station.” at all three points to see what the Explorers’ views of their lives were at each time. This would have been less coloured by my own preconceived notions about spending a year at an Arctic research station (see Section 4.1) and offered more room for the Explorers’ own experiences. If I had requested them to tell me about their lives, the weight of any objects or experiential claims might have been clearer. With the current questions, the word “extreme” determines an experiential quality which the Explorers filled with objects and claims themselves; while I clarified to them that “extreme” could be good, bad or different, a more generic question might have led to a different insight into their lives. I might have got answers about all objects and claims, not just the extreme or changed ones.

7.8.4 Quasi-Randomness in the SART

There was one oversight on my behalf with regard to the SART used here. It was quasi-random: the digits were displayed in a random but pre-set order each time while font size varied at complete random. So all participants saw the same digits in the same order each time but the size of the digit varied. However, their SART performance still fluctuated over time and between groups. While only the Explorers became faster at the SART, neither group made fewer errors over time which suggests that the SART did not become easier for them despite the quasi-random digit order. It is possible to set the SART to be truly random with a small change in its code but when checking the code, I did not notice this setting. Similarly, when conducting the SART with my participants I observed them for the warm-up trials and the first few of the actual trials. This was done to ensure that they had understood the task and were following the instructions. However, the SART lasted approximately four minutes and as I outlined before, the participants became quite anxious and even angry over it in their attempts to perform error-free. I did not want to exacerbate their feelings by observing them or their screen intrusively for four minutes while they completed this evidently stressful task. If I had done this, I might have noticed the repetition of the digits sooner, so this was an honest mistake on my side. Instead, I wrote notes on my behavioural observations of the participant in question during those four minutes. Their behaviour and the results of the SART do not suggest that it was an easy task for them to complete altogether, so this limitation might be a recommendation for future research, too: employ the truly random SART as well as the quasi-random SART and compare the results.

7.8.5 Limitations due to Sample Size

The limitation of my small sample size was addressed by taking great care with my statistical decision-making (see Section 2.8). Only one Explorer withdrew from my study which left me with ten others. Since there were only eleven Explorers in the winter team, this limitation could not have been addressed by increasing my recruitment efforts: there were no more potential participants than those eleven. If I had opted to run the study for an additional year, I might have got another ten Explorers but this would have cost me the control group so the choice was made to run this study on ten members in each group rather than only twenty Explorers. This limited sample size may result in a limited generalisability: it provides a thorough insight into a Polish Arctic team and may inform decisions with regard to future teams at the Polish Polar Station, but not to other Arctic stations. Décamps and Rosnet (2005) point out that this is the same in Antarctica and that generalisability is nearly impossible because of each expedition's group composition, regardless of sample size. The present study nevertheless provides valuable insight into psychocognitive functioning at the station and is thus of value for the station's institute. A useful approach to data such as the present one and Antarctic data, too, could be to collect as much of it as possible so that if any future expedition encounters major psychocognitive problems, an intervention or a solution could be modelled on the information from the most similar previous expedition. This would make a larger data set or even a data bank to consult in the event of necessity.

A side effect of my small sample size was that this sample was too small to investigate the results of the seasonal affective measurement of choice, the SPAQ. The SPAQ yields a seasonality type, either someone who feels best in the summer or in the winter. Apart from Jakub, all Explorers described themselves as feeling best in winter, or as mixed. This prevented any comparisons among them.

7.9 Future Research

As is often likely to happen in polar studies (Lugg, 1991), some of the equipment of the study was damaged during transport. Several studies from the 1960s and 1970s suggest a change in brain activity under Antarctic conditions (A. F. Barabasz, 1991; M. Barabasz, 1991) and I had intended to use Naish's (2009) methodology to detect changes in hemispheric laterality and brain activity over time. However, the LED glasses Naish (2009) used were damaged during their transport to the polar station via Royal Mail. This led to them being unusable despite Albert attempting to repair them on my behalf. A future research project could include this experiment to determine changes in brain activity. It is short and if the glasses are not damaged, easy and cost-efficient to run.

Additionally, the question of resilience could be addressed more thoroughly. Both the POMS and the SCL-90-R have shown interesting fluctuations over time and in comparison to the control group, validating their application in polar research. It would now be good to establish monthly fluctuations on both questionnaires to gain a more detailed insight into any possible patterns such as the TQP. The questionnaires can easily be collected via hardcopies left behind at the station, it would need to be ensured that they reach the researcher safely and confidentially when completed. Alongside this assessment, open-ended questionnaires or interviews could be conducted to allow the participants room to explain what they find stressful and how they cope with the stressors. This information would be valuable in preparing future crews.

It would also be interesting to see monthly fluctuations in the SART and perhaps the TEA. The SART should be collected prior to the Arctic deployment and then at regular intervals during Arctic employment. The controls improved non-significantly over time and practice effects in the SART have not been documented to date (Manly, Lewis, Robertson, Watson, & Dattaa, 2002). This suggests that even with more than three Arctic testing points, the SART should not lead to improvements. Comparing the Explorers in their home environment and their Arctic environment would be paramount to establish that the SART deficiencies are due to Arctic behavioural inhibition. It might be worthwhile to collect blood samples in addition to the cognitive tests to assess any changes in thyroid hormone levels that could indicate the PT3. The PT3 has been shown to influence Antarctic winterers and there have been no studies on it in Arctic winterers.

7.10 Conclusions

This research focused on an isolated Polish team who wintered at the Polish Polar Station, Hornsund. Their mental health, mood, and cognition were assessed quantitatively while their personal experiences were explored via interviews. The results show that confusion and vigor continuously declined over their time at the station. This was likely due to them settling in and the exciting novelty fading into set routines over the year. The time which showed the most hostilities and depressive behaviour was in spring, after the winter isolation had ended. Experientially, the Explorers reported mixed feelings: during the winter they found it very difficult to maintain team cohesion and satisfaction. Everyone went to great personal lengths at controlling their treatment of others to ensure that no overt conflicts would arise. However, in hindsight, they indicated that winter was their favourite phase because it was peacefully quiet with only the eleven of them. This was in comparison to the summer times when more people stayed at the station and there was more stressful work. The Explorers' immense behavioural self-discipline over the year went alongside in a decreased performance in an inhibition task, the SART, in comparison to a set of matched controls. The Explorers performed similar to a set of patients with damage to their rIFC.

The results also suggest that Explorers with higher neuroticism were more likely to struggle emotionally over the polar night, they were particularly prone to depression and anxiety. This is in line with the case study of Albert who described great emotional and cognitive changes and suffering over the polar night. Albert also scored higher than the other Explorers or a set of case controls on neuroticism. Despite his emotional problems, Albert was well-liked by his peers and they missed him when he decided to leave. Neuroticism as a personality trait, however, did not associate with being chosen for another winter. Being friendly and being competent related to being chosen for another winter by the other Explorers.

This research shows several novel findings: cognitive inhibition tasks are impaired over ICE residence but attentional flexibility remains intact, other team members are the most stressful and dangerous aspect of the mission, positive experience includes natural beauty and the overcoming of adversity and neuroticism associates with greater emotional problems but a person with high levels of neuroticism may still be well-liked by her/his colleagues. This knowledge is new in the overall field of polar psychology. Another original aspect of this study is that it took place in the Arctic rather than the Antarctic, and that it featured a Polish team.

Future research might explore the question of a suitable winter candidate further and include more measures of inhibition.

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148. Wagenmakers, E.-J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., . . . Morey, R. D. (2017). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic Bulletin & Review*. doi:10.3758/s13423-017-1343-3

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151. Weybrew, B. B. (1991). 10. Three decades of Nuclear Submarine Research: Implications for Space and Antarctic Research. In A. A. Harrison, Y. A. Clearwater, & C. McKay (Eds.), *From Antarctica to Outer Space: Life in Isolation and Confinement* (1 ed., pp. 103-114). New York: Springer Verlag New York, Inc.

152. Wood, J., Hysong, S. J., Lugg, D. J., & Harm, D. L. (2000). Is it Really So Bad? A Comparison of Positive and Negative Experiences in Antarctic Winter Stations. *Environment and Behavior, 32*(1), 84-110. doi: 10.1177/00139160021972441
153. Xu, C., Zhu, G., Xue, Q., Zhang, S., Du, G., Xi, Y., & Palinkas, L. A. (2003). Effect of the Antarctic environment on hormone levels and mood of Chinese expeditioners. *International Journal of Circumpolar Health, 62*(3), 255-267.
154. Zalewski, M., Górski, M., Weslawski, M., Glowacki, P., & Nowosielski, L. (2007). *50 Years of the Hornsund Polish Polar Station (Spitsbergen, Svalbard)* (M. Puczko Ed.): Instytut Geofizyki PAN.

Appendix A: Supplementary Tables to the Literature Review.

Table A1

The 43 Papers Excluded from the Literature Review in Section 1.4.

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Albretsen, C. S. (1996). [Roald Amundsen--a study of personality]. Tidsskrift for Den Norske Laegeforening, 116(30), 3640–3642.				×	
Albretsen, C. S. (2003a). Hjalmar Johansens selvmord. Tidsskrift for Den Norske Laegeforening, 123(24), 3536–3538.				×	
Albretsen, C. S. (2003b). [The challenges for physicians on polar expeditions around the year 1900]. Tidsskrift for Den Norske Laegeforening, 123(24), 3540–3542.				×	
Andersen, K. . (1968). [The biological adaptability of man]. Nordisk Medicin, 79(13), 406–408.			×		
Andersen, T. (1979). Ill health in two contrasting societies, particularly non-psychiatric morbidity among those with a psychiatric diagnosis. Psychotherapy & Psychosomatics, 32(1–4), 249–256.		×			
Anthi, P. R. (1999). Roald Amundsen: a study in rivalry, masochism and paranoia. International Journal of Psycho-Analysis, 80(5), 995–1010.				×	

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Arctic research: what, why, how? (1988). Alaska Medicine, 30(1), 20–23.	×				
Brennen, T., Martinussen, M., Hansen, B. O., & Hjemdal, O. (1991). Arctic Cognition: A Study of Cognitive Performance in Summer and Winter at 69 Degrees North. Applied Cognitive Psychology, 13, 561–580.		×			
Coming in from the cold. (2006). Nature, 441(7090), 127.	×				
Griofa, M. O., Blue, R. S., Cohen, K. D., & O'Keeffe, D. T. (2011). Sleep stability and cognitive function in an Arctic Martian analogue. Aviation Space & Environmental Medicine, 82(4), 434–441.		×			
Gunderson, E. K. E. (1968). Mental Health Problems in Antarctica. Archives of Environmental Health: An International Journal, 17(4), 558–564. https://doi.org/10.1080/00039896.1968.10665281	×				
Hanlon, J. J. (1972). Interaction between man and the Arctic environment. Past, present, and prospective. Archives of Environmental Health, 25(4), 234–238.	×				
Harrison, A. A., Clearwater, Y. A., & McKay, C. P. (1989). The human experience in antarctica: Applications to life in space. Behavioral Science, 34(4), 253–271. https://doi.org/10.1002/bs.3830340403	×				

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Huntington, H. P. (2011). Arctic science: The local perspective. Nature, 478, 182–183. https://doi.org/10.1038/478182a			×		
Jacobsen, B. K., Hasvold, T., Hoyer, G., & Hansen, V. (1995). The General Health Questionnaire: how many items are really necessary in population surveys? Psychological Medicine, 25(5), 957–961.		×			
Kintisch, E. (2015). Don't mess with the bears. Science, 349(6248), 581–581. https://doi.org/10.1126/science.349.6248.581	×				
Klen, T. (1992). Accidents in the Arctic. A psychological point of view. Arctic Medical Research, 51(7), 71–76.			×		
Krivoschekov, S. G., & Shishkina, T. N. (1998). Psycho-physiological mechanisms of adaptation of rotation personnel in Arctic regions. International Journal of Circumpolar Health, 57(1), 427–431.		×			
Lathan, C., Spira, J. L., Bleiberg, J., Vice, J., & Tsao, J. W. (2013). Defense Automated Neurobehavioral Assessment (DANA)-psychometric properties of a new field-deployable neurocognitive assessment tool. Military Medicine, 178, 365–371. https://doi.org/10.7205/MILMED-D-12-00438		×			

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Lugg, D. J. (1988). Antarctica--lessons for health care planning and delivery to circumpolar populations. Arctic Medical Research, 47 Suppl 1, 360–364.	×				
Lugg, D. J. (1990). Humans on ice: a review of research on those living in Antarctica since IGY 1957-58. Arctic Medical Research, Suppl, 499–501.	×				
Lugg, D. J. (2005). Behavioral Health in Antarctica: Implications for Long-Duration Space Missions. Aviation, Space, and Environmental Medicine, 76(6), B74–B77.	×				
McNabb, S. (2004). Arctic research at three levels. International Journal of Circumpolar Health, 1, 13–18.	×				
Mervis, J. (2009). POLAR SCIENCE: A Death in Antarctica. Science, 323(5910), 32–35. https://doi.org/10.1126/science.323.5910.32	×				
Ohno, G., Watanabe, K., Okada, Y., & Higuchi, K. (2012). Practical experience of telehealth between an Antarctic station and Japan. Journal of Telemedicine and Telecare, 18(8), 473–475. https://doi.org/10.1258/jtt.2012.GTH111	×				

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Olson, J. J. (2002). Antarctica: a review of recent medical research. Trends in Pharmacological Sciences, 23(10), 487–490. https://doi.org/10.1016/S0165-6147(02)02087-4	×				
Palinkas, L. A. (1989). Sociocultural influences on psychosocial adjustment in Antarctica. Medical Anthropology, 10(4), 235–246. https://doi.org/10.1080/01459740.1989.9965970	×				
Palinkas, L. A. (1990). Psychosocial effects of adjustment in Antarctica - Lessons for long-duration spaceflight. Journal of Spacecraft and Rockets, 27(5), 471–477. https://doi.org/10.2514/3.26167	×				
Palinkas, L. A. (2001). Mental and cognitive performance in the cold. International Journal of Circumpolar Health, 60(3), 430–439.	×				
Palinkas, L. A. (2003). The psychology of isolated and confined environments: Understanding human behavior in Antarctica. American Psychologist, 58(5), 353–363. https://doi.org/10.1037/0003-066X.58.5.353	×				
Palinkas, L. A. (2010). Coming out of the cold and stepping into the light: human adaptation in high latitude environments. International Journal of Circumpolar Health, 69(3), 214–216.	×				

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Palinkas, L. A., Gunderson, E. K. E., Johnson, J. C., & Holland, A. W. (2000). Behavior and performance on long-duration spaceflights: Evidence from analogue environments. Aviation, Space, and Environmental Medicine, 71(9,Sect2,Suppl), A29–A36.	×				
Palinkas, L. A., & Suedfeld, P. (2008). Psychological effects of polar expeditions. The Lancet, 371(9607), 153–163. https://doi.org/10.1016/S0140-6736(07)61056-3	×				
Parkinson, A. J. (2011). The international polar year: continuing the arctic human health legacy. International Journal of Circumpolar Health, 70(5), 447–449.	×				
Parkinson, A. J. (2013). The Arctic Human Health Initiative: a legacy of the International Polar Year 2007-2009. International Journal of Circumpolar Health, 72. https://doi.org/10.3402/ijch.v72i0.21655	×				
Reed, H. L., Silverman, E. D., Shakir, K. M. M., Dons, R., Burman, K. D., & O'Brian, J. T. (1990). Changes in Serum Triiodothyronine (T 3) Kinetics after Prolonged Antarctic Residence: The Polar T 3 Syndrome*. The Journal of Clinical Endocrinology & Metabolism, 70(4), 965–974. https://doi.org/10.1210/jcem-70-4-965			×		

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Sandal, G. M. (1998). The effects of personality and interpersonal relations on crew performance during space simulation studies. Life Support & Biosphere Science: International Journal of Earth Space, 5(4), 461–470.	×				
Stuster, J. (1998). Human and team performance in extreme environments: Antarctica. Human Performance in Extreme Environments: The Journal of the Society for Human Performance in Extreme Environments, 3(1), 117–120.	×				
Suedfeld, P. (1998). What can abnormal environments tell us about normal people? Polar stations as natural psychology laboratories. Journal of Environmental Psychology, 18(1), 95–102.	×				
Suedfeld, P., & Weiss, K. (2000). Antarctica: Natural Laboratory and Space Analogue for Psychological Research. Environment and Behavior, 32(1), 7–17. https://doi.org/10.1177/00139160021972405	×				
Tafforin, C. (2004). Ethological analysis of a polar team in the French Antarctic station Dumont d'Urville as simulation of space teams for future interplanetary missions. Acta Astronautica, 55(1), 51–60. https://doi.org/10.1016/j.actaastro.2003.12.015			×		

Reference	Reason for Exclusion				
	Not original	Lack of polar and/or ICE variables	Lack of psychological variables	Historical	Lack of full text
Tafforin, C. (2015). Confinement vs. isolation as analogue environments for Mars missions from a human ethology viewpoint. Aerospace Medicine & Human Performance, 86, 131–135. https://doi.org/10.3357/AMHP.4100.2015			×		
Taylor, A. J. W. (1998). Psychological adaptation to the polar environment. International Journal of Circumpolar Health, 57(1), 56–68.	×				

Table A2

Detailed Overview of the Cognitive Polar Studies.

Study Type	Publication	Tests Used
Field (Antarctica) & Laboratory	Pääkkönen (2010)	ANAM-ICE: code substitution, code substitution – delayed, continuous performance, logical reasoning, matching-to-sample, simple RT and Sternberg memory search
Laboratory Only	Palinkas, Mäkinen, Pääkkönen, Rintamäki, Leppäluoto & Hassi, 2005	Naval Medical Research Institute Performance Assessment Battery (NMRI-PAB) Matching-to-Sample, Simple Reaction Time, Serial Addition/Subtraction, Grammatical Reasoning, Repeated Acquisition of Response Sequences

Study Type	Publication	Tests Used
Laboratory Only	Mäkinen et al., 2006	ANAM ICE Code substitution/delayed Logical Reasoning Matching-to-sample Continuous Performance Simple Reaction Time Sternberg Memory Search
Laboratory Only	Palinkas et al., 2007	ANAM-ICE: Code substitution/delayed Continuous performance Logical Reasoning Matching to Sample Simple Reaction Time Sternberg Memory
Field Only (Antarctica)	Paul et al., 2010	Task Acquisition Delayed recognition Attention and concentration Digit Symbol Substitution
Field Only (Norwegian military camps)	Hodgdon et al., 1991	Essex Performance Battery Sternberg memory search pattern recognition code substitution tapping four-choice reaction time